

**STANDARD DESIGN CRITERIA
AND
STANDARD CONSTRUCTION
REQUIREMENTS**

Town of Wellington, Colorado



March 2015

Revised April 2017



Presented by

Stantec

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REVISIONS

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DIVISION 1 –
GENERAL REQUIREMENTS

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SECTION 01000

GENERAL REQUIREMENTS

PART 1 PURPOSE

The purpose of the Town of Wellington construction standards and specifications is to provide the minimum standards and specifications to be adhered to in the design and construction in the Town of Wellington, Colorado. All improvements must meet the requirements of the Town of Wellington and all work must be acceptable to the Town of Wellington.

- 1.1** Projects shall comply with all Laws, Regulations, Codes and Ordinances applicable to the design and the furnishing and performance of the work. Except where otherwise expressly required by applicable Laws, Regulations, Codes or Ordinances the Town shall be responsible for monitoring compliance with any Law, Regulation, Code or Ordinance.
- A.** Whenever the provisions of these Standards are found to be inconsistent with any other regulations or codes, the regulation code imposing the more restrictive standards shall control. The provisions of these regulations are minimum requirements that do not preclude imposition of more restrictive standards by agreement or by law.
 - B.** The Town is authorized to enforce all provisions of these Standards and Specifications; or may appoint a civil engineer, construction inspector, any other related technical employee, or any consulting firm engaged specifically to act on Town's behalf.
 - C.** Whenever any work is being completed contrary to the provisions of the Standards and Specifications the Town has the authority to order said work to be stopped. Notice to such effect will be presented to the Contractor. Work may not commence until authorized by the Town.
 - D.** All items and work not covered by these specifications shall be discussed with the Town and the Developer, Design Engineer or Contractor shall receive written approval prior to commencing said item or work.
 - E.** The Town, or Town's authorized representatives charged with the enforcement of these Standards and Specifications, acting in good faith will not thereby be rendered personally liable for any damage that may accrue to persons or property as a result of any act or by reason of any act or omission in the discharge of their duties.
 - F.** Whenever there are practical problems involved in following the provisions of the standards and specifications the Town may grant modifications. It is up to

the discretion of the Town's Public Works Department whether or not a variance in the standards and specifications is warranted. Any modifications must be in writing and must not lessen the design integrity or requirements, and shall be recorded into the Town's files.

G. All required fees must be paid, in advance, to the Town.

1.2 It is the intent and purpose of the standards and specifications to obtain high quality construction throughout, with the completed work complying with the standards and specifications.

A. The Standards are complementary: what is called for by one is as binding as if called for by all. It is the intent of the Standards to require a functionally complete Project (or part thereof) to be constructed in accordance with these Standards. Any work, materials or equipment that may reasonably be inferred as being required to produce the intended result will be provided whether or not specifically called for. When words which have a well-known technical or trade meaning are used to described Work, materials or equipment such words shall be interpreted in accordance with that meaning.

B. Reference to standard specifications, manuals or codes of any technical society, organization or association or to the Laws or Regulations of any governmental authority, whether such reference be specific or by implication, shall mean the latest standard specification, manual, code or Laws or Regulations in effect at the time of Town approval. However, no provision of any referenced standard specification, manual or code shall be effective to change the duties and responsibilities of the Town or any of their consultants, agents or employees from those set forth in these standards. Work shall be done in a careful manner to the satisfaction of the Town.

C. All materials and equipment shall be of good quality and new. If required by Town, Contractor shall furnish satisfactory evidence (including reports of required tests) as to the kind and quality of materials and equipment. All materials and equipment shall be applied, installed, connected, erected, used, cleaned and conditioned in accordance with the instructions of the applicable Supplier and manufacturer, except as otherwise provided in these Standards: but no provision of any such instructions will be effective to assign to Town, or any of Town's representatives, any duty or authority to supervise or direct the furnishing or performance of the Work.

D. In these Standards and Specifications any reference made in singular may be construed as plural as well as any reference made in the masculine may be construed as feminine.

E. When deemed necessary by the Town, the Developer shall submit a certificate to the Town, secured from manufacturer of all the material used as a

permanent part of the project, stating that their product as used on the project conforms to all Town specifications. No material shall be used until the certificates are approved by the Town.

- F.** All manufacturer's recommendations, instructions, or specifications regarding installation and use of products shall be considered a part of these specifications and of equal force. Any conflict between the manufacturer's instructions and these Standards and Specifications shall be decided and settled by the Town's Public Works Department and shall not be open for arbitration. All such manufacturer's instructions shall be presented to the Town for approval at the same time as the certificates of quality are presented.
- G.** If in the Town's opinion there is evidence that materials or methods used do not comply with the Standards and Specifications, the Town may require that tests be performed for conformation. Testing methods will be specified by the Town and their expense shall be solely borne by the Contractor or the Developer.

1.3 The Developer is responsible for obtaining all necessary permits for construction. All permits must be in accordance with Town, County, State, or Federal requirements. Town approval and review of all permits must be accomplished prior to the start of any construction. Examples of permits/certifications that might be required are:

- US Army Corps of Engineers 404
- State of Colorado Department of Public Health and Environment 401
- Colorado Department of Transportation access or utility
- NPDES
- Railroad

A copy of all permits must be available for inspection at all times on the job.

1.4 The Developer will provide the Town with letters of credit or performance bonds for all public improvement construction projects greater than \$1000. The value of the letters of credit or performance bonds will be in the amount of Work value as determined by the Town Engineer.

PART 2 SCOPE OF WORK

2.1 SAFETY AND PROTECTION

- A.** Contractor shall be responsible for initiating, maintaining and supervising all safety precautions and programs in connection with the Work. Contractor shall take all necessary precautions for the safety of, and shall provide the necessary protection to prevent damage, injury or loss to:
1. All employees on the Work and other persons and organizations who may be affected thereby
 2. All the Work and materials and equipment to be incorporated therein
 3. Other property at the site or adjacent thereto, including but not limited to, trees, shrubs, lawns, walks, pavements, roadways, structures, utilities and underground facilities not designated for removal, relocation or replacement in the course of construction.
 4. Public who may be affected by the project.
- B.** Contractor shall comply with all applicable Laws and Regulations of any public body having jurisdiction for the safety of persons or property or to protect them from damage, injury or loss: and shall erect and maintain all necessary safeguards for such safety and protection. Contractor shall notify, in writing, owners of adjacent property, underground facilities and utility owners when execution of the Work may affect them, and shall cooperate with them in the protection, removal, relocation and replacement of their property. All damage, injury or loss to any property caused, directly or indirectly, in whole or in part, by Contractor, any Sub-Contractor, Supplier or any other person or organization directly or indirectly employed by any of them to perform or furnish any of the Work or anyone for whose acts any of them may be liable, shall be remedied by Contractor. Contractor's duties and responsibilities for the safety and protection of the Work shall continue until such time as all the Work is completed and accepted by the Town of Wellington.
- C.** If a representative of the Town of Wellington deems an unsafe situation develops where they are required to inspect the work, the Contractor shall take the necessary steps to protect the Town representative prior to proceeding with the work. Nothing within the provision to protect Town representatives shall be construed as relieving the Contractor from being responsible for initiating, maintaining, or supervising all safety precautions and programs in connection with the Work.

2.2 SOILS REPORT

A complete soils report for a proposed project shall be submitted with the final plans. It must be prepared by a registered Professional Engineer and shall contain

adequate information to evaluate the submitted designs. The cost of testing will be paid by the Developer or the Design Engineer.

2.3 CONSTRUCTION ACCEPTANCE

Public improvement construction shall be completed in strict compliance with the approved plans. Upon improvement installation, Town inspection, and finding of acceptability, the Town shall issue a letter of construction acceptance for the project or applicable phase. When construction acceptance has been issued for all public improvements, the project or applicable phase is eligible for building permits and release of 90% of the letters of credit or performance bond.

2.4 WARRANTY PERIOD

A. Definition of the Warranty Period

The Warranty Period for all Public Improvements shall be **two (2) years**. The Warranty Period shall start the date that Construction Acceptance occurs. The Warranty Period shall end with the Final Acceptance of the Public Improvements. If deficiencies are noted during the Town's warranty inspection, the Developer shall repair the deficiencies. Repair or acceptance of the deficiencies shall occur at the expiration of any such extension. A new Warranty Period shall not be applied to any repair work performed during the warranty period.

B. Time Frames for Completing Repair

At any time before the completion of the Warranty Period, the Town may notify the Developer of needed repairs. If repair areas are considered to be an imminent danger to the public health, safety, and welfare, the Contractor shall act within 24 hours to complete the repair. If the work is not considered a safety issue, the Developer has ten (10) working days to schedule the work, and sixty (60) calendar days to complete the work. Extensions of time may be considered when necessary due to weather constraints.

C. Failure to Complete Repair

If the Developer has not completed the warranty repairs in the time frame specified, the Town may choose to effect the necessary repairs. The Town will either invoice the Developer for all costs for the related work plus a \$500.00 administrative fee or it will collect from the letters of credit or bonds.

D. Responsibility for Maintenance

The Developer is responsible for maintaining all public improvements, including sweeping, throughout the Warranty Period.

2.5 FINAL ACCEPTANCE

Two (2) years after Construction Acceptance, the Town shall inspect the public improvements. Any construction not meeting Town standards shall be brought into compliance by the Developer. When all Town standards have been met, final acceptance shall be granted and the remaining 10% of letters of credit or performance bonds will be released.

A. If final acceptance is not granted, all future maintenance and repair shall remain the responsibility of the Developer. If identified deficiencies are not corrected and finally accepted within 120 days after the Construction Acceptance period, no further building permits or certificate of occupancy shall be issued for the project or applicable phase until deficiencies are corrected and accepted.

PART 3 ABBREVIATIONS AND DEFINITIONS

3.1 ABBREVIATIONS (periods may not be included in these standards)

A.A.S.H.T.O. - American Association of State Highway and Transportation Officials

A.C.I. - American Concrete Institute

A.N.S.I. - American National Standards Institute.

A.S.C.E. - American Society of Civil Engineers

A.S.M.E. - American Society of Mechanical Engineers

A.S.T.M. - American Society for Testing and Materials.

A.P.W.A. - American Public Works Association.

A.W.W.A. - American Water Works Association.

C.D.P.H.E. - Colorado Department of Public Health and Environment.

C.D.O.T. - Colorado Department of Transportation.

U.B.C., U.P.C., U.F.C. - Uniform Building, Plumbing & Fire Codes.

W.E.F. - Water Environment Federation.

3.2 DEFINITIONS

APPROVED PLAN - The latest revised construction plan approved by the Town.

CODE - Shall mean the official adopted Town of Wellington Municipal code.

CONTRACTOR - Shall mean a person, partnership or corporation duly insured to perform Work in the Town of Wellington.

CONTRACTOR'S REPRESENTATIVE - Shall mean the owner, superintendent, foreman, or any person designated by the Contractor to be responsible for construction in the field.

CONTRACT DOCUMENTS - The Contract Documents include these Standard Specifications, Town approved Drawings, and Town approved changes to the Work.

DESIGN ENGINEER - Shall refer to the engineer responsible for the design, plans and specifications, and the field surveys of a specific project.

DEVELOPER - Shall mean the person or entity developing a project.

DRAWINGS – Shall refer to construction drawings for civil infrastructure prepared by a registered Professional Engineer.

INFILTRATION - Refers to extraneous flow (excluding sewage) which enters a sewer system at pipe connections to manholes, or through joints in manholes or pipe, or because of breaks in pipe or joints, corrosion of pipe, poor construction, or ground movement.

INSPECTOR – Shall refer to an authorized representative of the Town of Wellington (consulting engineer or Town employee) responsible for inspection of public improvements on behalf of the Town.

INFLOW - Refers to the extraneous flow in sewer systems from sources other than infiltration, such as basement drains, roof drains, manhole covers, etc.

PROFESSIONAL ENGINEER - A registered engineer licensed with the State of Colorado.

PUBLIC IMPROVEMENT - Includes all construction that falls under the Town of Wellington's jurisdiction, including streets, grading, utilities, services, landscaping, drainage, and subdivisions.

RECORD DRAWING (A.K.A. "AS-BUILTS", "DRAWINGS OF RECORD") – Shall refer to civil infrastructure drawing showing as-built conditions of a project.

SANITARY SEWER - Refers to a sewer that carries wastewater from residential, industrial and commercial facilities to the sewage treatment plant.

SERVICE CONNECTION - Are the extensions from individual properties to the public utility facilities.

STANDARDS AND SPECIFICATIONS - Shall refer to the standards and specifications for the Town of Wellington.

SUB-CONTRACTOR – Shall mean a person, partnership or corporation duly insured to perform Work under the Contractor for a project in the Town of Wellington.

SUPPLIER - Shall mean a person, partnership or corporation duly insured to supply material or equipment to the Contractor or any Sub-Contractor for Work on a project.

TOWN - Shall mean the Town of Wellington, Colorado and/or its authorized representative (consulting engineer or Town employee) acting on behalf of the Town.

UTILITIES - Shall mean all utilities on site prior to the time of any design; such as but not limited to water lines, sanitary sewer lines, drainage lines, electric lines, gas lines, telephone lines, and cable television lines.

WASTEWATER - means the water-carried and liquid wastes from dwellings, commercial buildings, institutions and industrial facilities discharged to the Public Owned Treatment Works, (POTW), sewer system together with any groundwater, surface water and storm water that may be present.

WORK – Shall mean all civil infrastructure work (public and private) including but not limited to, sewer pipes and manholes, waterlines, storm sewer and roadway improvements, that will be constructed with the project.

Wherever the words "as directed", "as required", "as permitted", or words of like meaning are used, it shall be understood that the direction, requirements or permission of the Town is intended. Similarly, the words "approved", "acceptable", and "satisfactory" shall refer to approval of the Town. References made to standards and specifications, methods of testing materials, codes, practices, and requirements are understood to be the latest revision of said references and shall govern unless a specific revision is stated.

PART 4 DRAWINGS AND SPECIFICATIONS

4.1 PRELIMINARY SUBMITTAL

- A.** Two (2) electronic copies (pdf and dwf format) of the preliminary plans (22"x34" sheets), one electronic copy of project information report (pdf format) and such other information as the Town may deem necessary shall be submitted to the Town of Wellington for review. One (1) electronic set of plans shall be returned with comments for revision.

1. Two (2) electronic copies (pdf and dwf format) of the revised construction plans shall be submitted for final review, and approval.
2. Upon approval from the Town, three (3) full size (22"x34") hard copies of the final plans, one of which is to be a high quality reproducible set, shall be submitted to the Town along with 3 half size (11"x17") copies. All printed sets submitted must be signed, sealed and dated by a Colorado Registered Professional Engineer. Two (2) electronic copies (pdf and dwf format) of the approved construction plans shall also be submitted for Town electronic files.

B. Project Information Report

1. A project information report is to be submitted with the preliminary construction plans. It is to include the following information:
 - a The initial and ultimate area, in acres, to be developed.
 - b The estimated population densities and total population to be served.
 - c The estimated quality and quantity of any industrial waste to be discharged into the sanitary sewer.
 - d Design flow rates, average, maximum, and infiltration allowances for the sanitary sewer.
 - e If alternate methods of providing utility services are possible (e.g. raw water for irrigation), the report shall give an evaluation of the alternative method (e.g. groundwater well location, size and capacity).
 - f Estimated average daily water usage including landscaping.
 - g Estimated amount of water to be used by industrial and commercial facilities.
 - h Any other information that would affect the Town's ability to service the new area, or any other information requested by the Town. This shall include, but not be limited to, any water rights that might be obtained as a result of the development.

4.2 FINAL PLANS AND SPECIFICATIONS

- A.** Prior to the Contractor beginning The Work, an approved set of plans and specifications must be on file with the Town of Wellington. All contracts, bonds, insurance, permits and licenses must be fully executed. Contractor

shall have a copy of these Standards and Specifications on the site at all times during construction.

1. All plans, specifications, and calculations submitted to the Town of Wellington for review must be prepared by or under the direct supervision of a Professional Engineer duly registered and licensed to practice engineering in the State of Colorado. All plans, specifications, and calculations should indicate this by being signed and dated by the Professional Engineer along with their registration number and seal. The registered Professional Engineer responsible for the design of the system shall be known as the Design Engineer, and shall be responsible for all plans and specifications. Approval by the Town shall in no way relieve the Design Engineer of the responsibility for errors or omissions in design, plans, specifications or field surveys. Any errors shall be corrected by the Design Engineer to the satisfaction of the Town at no cost or expense to the Town.
2. Town's review and approval will only be to determine if the plans, specifications and construction conform to the Town's requirements. Town's review and approval will not relieve Owner/Developer, Design Engineer and Contractor from responsibility for any variation from the Town requirements. The Town's review and approval shall not constitute any assumption of responsibility or liability for the design or construction.
3. All construction plan sheets submitted to the Town of Wellington, for review shall be on 22"x34" sheets with scribed lettering or legible equivalent. All sheets except the cover sheet are to include a title block which will include in it, the name of the owner or Developer; the name of the subdivision or project; the improvement description and location; the name, address, and telephone number of the Design Engineer or the firm; the date prepared. Additionally sheets will be numbered, include a revision box and if necessary, a legend to designate existing and proposed utilities, lot lines, street Right-of-Way, easements and other lines as needed for clarity.

B. In addition to the general provisions described above the plan set shall include the following:

1. Cover sheet - shall include but is not limited to the project name and location, a vicinity map, sheet index, name of the owner or Developer, name of the engineering firm responsible for the design and plans, general notes and an approval block, and additional information deemed necessary by the Town.
2. Master utility plan - shall include a general overview of the entire project including but not limited to such items as streets, alleys, proposed utility

lines, proposed sanitary sewer lines, existing utilities on and adjacent to the site, existing and proposed easements and right-of-ways.

3. Construction plans and profiles - shall include all necessary information required for the construction of the project (at a horizontal scale of not less than 1"= 60'; and a vertical scale of 1"= 10') including but not limited to the following information: key map; existing utilities; proposed & existing easements, right-of-ways, and property lines; proposed and existing service connections; diameter, type, and length of pipe between all fittings of proposed and existing water (raw and potable) and or sanitary sewer lines; location and type of all fittings; depth, and elevation on proposed water lines; depth, elevation, grade, manhole invert and rim elevations on proposed sanitary sewer lines; match lines indicating references to next sheets of design; water and sanitary sewer line locational tie downs to the center of the street; and survey stations. Also these sheets shall include north arrows and horizontal & vertical graphic scales.
4. Detail sheets - shall include but are not limited to details of any critical connections, crossings, or special fittings & appurtenances, and any other details that are deemed necessary by the Town. Town details shall be used and supplemented as needed.
5. All subdivision plats shall meet the requirements of Chapter 17 of the Wellington Municipal Code and be tied to a minimum of three (3) section monuments (quarter section or section corner) to establish basis of bearings.

4.3 PLANS AT CONSTRUCTION SITE

The Contractor shall be required to have a set of plans approved by The Town of Wellington on site at all times that construction is being completed.

4.4 CHANGES FROM APPROVED PLANS

Should circumstances warrant changes from the approved plans or specifications, the proposed revision must be submitted by the Design Engineer and approved by the Town, and approved copies given to the Contractor, Inspector, Developer, and Design Engineer. No work shall proceed on that portion of the project being revised until said revisions are submitted, approved, and distributed. Minor changes from the plans or specifications may be made only with written permission from the Town. It shall be the responsibility of the Developer to provide the Town with a set of "As Built" Mylar plans for any revisions (at the same scale as the original construction plan set) upon the completion of the project. This procedure shall be followed for all changes whether requested by the Town, the Design Engineer, the Contractor, or the Developer.

4.5 NOTIFICATION OF DESIGN ERRORS

Should any omissions or design errors be discovered after final approval of the plans, the Town shall notify the Developer and the Design Engineer. Following such notification, no work shall be allowed in the affected area until the revisions are made by the Design Engineer and submitted and approved by the Town.

4.6 RECORD DRAWINGS

It is the responsibility of the Developer to document deviations in the construction of public infrastructure from the approved design plans. Developer shall record the deviations clearly on the design plans and provide the Town of Wellington with a set of "RECORD DRAWINGS" consisting of reproducible plans prior to receiving Construction Acceptance.

Record Drawings shall be submitted in the following formats.

- A.** One (1) full size (22"x34") hard copy for review and approval
- B.** Upon receiving Town Approval the Record Drawings the following shall be submitted
 - 1. Electronic CAD files
 - 2. Electronic PDF files –signed and stamped by Design Engineer
 - 3. Two full size (22"x34") hard copies – signed and stamped by Design Engineer
 - 4. One half size (11"x17") hard copy or a half size electronic copy (pdf format)

PART 5 INSPECTION

5.1 GENERAL

- A.** The Town shall have the authority to reject defective, or inferior materials, or workmanship in cases where it is judged to be unacceptable, substandard, defective or suspect in accordance with these standards and specifications and good engineering judgement. The Contractor shall immediately correct any defective materials or poor workmanship as determined by the Town. The Town also has the authority to suspend The Work until such time that the Standards and Specifications are adhered to and the Contractor corrects the situation in question, subject to the satisfaction of the Town. If the Town deems it necessary, the previously covered work will be exposed at the Contractor's expense.

1. The Town shall not supervise, set out work, or provide line and grade stakes.
2. The Town shall at all times have control of the existing Water/Wastewater system. The Town is to have access to the construction site at all times. Connections to the existing Water/Wastewater system shall be made only under the Town's observation.
3. The Town maintains authority over the installation of any water or sanitary sewer service line:
 - a Water – Town is responsible for the service line from tap to curb stop. The owner is responsible for the service from curb stop to building.
 - b Sewer – The Town is responsible for the main pipe only. The owner is responsible for the service from the main to the building.

5.2 INSPECTION REQUIREMENTS

- A.** No construction work will be started until the Contractor has received all appropriate permit(s).
- B.** Inspection shall be required as follows:
 1. During trenching operations.
 2. During pipe laying operations.
 3. During backfill operations and compaction.
 4. During service connections to the existing system.
 5. During testing of water, wastewater, and storm drain lines, and disinfecting of water lines.
 6. Placement of asphalt, and curb and gutter.
 7. Paving operations.
 8. Inspection of subgrade prior to base.
 9. Inspection of base prior to paving.
 10. Prior to concrete placement.
 11. Inspection of all materials prior to installation.
 12. Other times at the Town's discretion.

13. During Town inspection of sanitary sewer service and water service connections, Contractor shall be present on-site with building permit in hand.

C. The Town shall be notified at least twenty-four (24) hours in advance when pipes are to be laid in any trench. No pipes, joints, or service connections shall be covered until they have been inspected by the Town.

D. The Contractor is to supply any inspection aids that are necessary for inspection such as a pump system for hydrostatic testing and a compression system for air testing of sanitary sewer lines, ladders or lights.

E. The Contractor is to supply any materials necessary for BacT testing of the public potable waterlines.

PART 6 SITE ISSUES

6.1 PRE-CONSTRUCTION CONFERENCE

When required a Pre-Construction conference shall be held at least 48 hours prior to the start of any construction or any topic regulated herein. The Contractor, Developer, Town, Design Engineer, and any interested utility representative shall be in attendance.

6.2 COMMENCEMENT OF CONSTRUCTION

Construction shall commence within one (1) year of the approved date shown on the plans, or plans must be resubmitted for review and approval. If construction is halted for more than one (1) year, plans must be resubmitted for review and approval. All improvements will be accurately surveyed and staked in accordance with the approved plans prior to their construction.

6.3 NOTIFICATION OF CONSTRUCTION

The Contractor shall notify all utility companies and locate all existing utilities on and near the site prior to construction. Also all affected parties must be notified prior to the commencement of work in order to insure that there will not be any unexpected interruptions of services during construction.

6.4 TRAFFIC CONTROL

Construction warning signs and sign placement shall conform to the Manual on Uniform Traffic Control Devices (M.U.T.C.D.). As directed by the Town, the Contractor shall submit for review and approval, a detailed traffic detour and control plan as well as a schedule prior to the commencement of any work. The Contractor shall furnish and maintain the approved construction traffic control plan throughout all phases of construction.

- A. Use of streets by trucks and commercial vehicles shall comply with the Town of Wellington Rules and Regulations with regard to truck routes and overweight vehicles.
- B. Work on Cleveland Avenue (CO State Hwy 1) will require CDOT approval.

6.5 RESPONSIBILITY FOR DAMAGE

Should any utility or private property be damaged during construction operations, the Contractor shall immediately notify the owner of such utility or private property, and unless authorized by the owner of the utility or private property, the Contractor shall not attempt to make repairs. The Contractor will be liable for all damages and shall hold the Town harmless from any liability or expense for injuries, damages, or repairs to such facilities.

6.6 INTERRUPTION OF SERVICE

The Contractor shall notify the Town (48) forty-eight hours in advance when installing any connection which will result in the interruption of water or sanitary sewer service to an existing customer. This will allow the following to be completed by whomever the Town designates.

- A. All affected customers shall be notified twenty-four (24) hours in advance in writing. The notices shall be delivered to each customer. An attempt shall be made to deliver the notice personally to the customer; otherwise the notice shall be left at the customer's door.
- B. The **Wellington Fire Protection District** shall be notified at least twenty-four (24) hours in advance of any water shut off. A description of the boundaries of the affected area and the location of all fire hydrants in the area shall be provided to the fire department.
- C. In commercial areas any disruption of service shall be undertaken only after said disruption has been coordinated with the Town and the private property owner. Coordination shall be required for both the service change over and any connections made to the existing system.
- D. A normal outage shall be a maximum of (4) four hours. If the outage will be greater than (4) hours, then work shall be done in a manner so as to minimize the inconvenience to the customer, and shall be subject to the approval of the Town. The Town shall notify the Contractor of the timing of the connection. Off hours and weekends may be required by the Town.
- E. If in the process of installing a connection, a condition exists when an industry or building cannot be out of water or sanitary sewer, the Contractor shall be

required to provide an appropriate means of providing water and/or sanitary sewer service to the affected customer during the installation of the connection.

6.7 RELOCATION OF EXISTING UTILITIES

In the event that during construction it is determined that any underground utility conduit, including but not limited to, sanitary sewer mains, water mains, electric lines, communication lines, gas mains, and drainage and ditch structures and any above ground utility facilities are required to be relocated or renewed, the Contractor shall notify the utility owner within 48 hours of Contractor's approach to such utility so that arrangements with the Town and/or owners of the affected utility can be completed without delay of The Work.

6.8 SWEEPING AND CLEANING OF ROADS AND RIGHT-OF-WAY DURING CONSTRUCTION

The Contractor shall be responsible for the daily removal and proper disposal of all debris resulting from construction activity, dirt, and mud from all the public streets, private property or driveways, and parking lots within or adjacent to the project area, whether caused directly by the Contractor's construction operation, or that of Sub-Contractors and/or material suppliers, or indirectly due to the work site conditions in general. The Contractor shall be responsible for any damage caused due to maintenance and/or cleaning operations, or the lack thereof.

6.9 MATERIAL STORAGE AND HANDLING

All materials will be stored in a manner so as to preserve their quality and suitability for the work. All pipe, fittings, valves, hydrants, and accessories shall be loaded and unloaded by lifting with hoists, skidding, or by hand so as to avoid shock or damage. Under no circumstances shall material be dropped. Pipe handled on skidways will not be skidded or rolled against pipe already unloaded. Cast iron, ductile iron, and steel pipe will be handled so that the coating or lining will not be damaged. If any part of the coating or lining is damaged the repair shall be made to the satisfaction of the Town, by the Contractor or Developer at no expense to the Town. Any material judged by the Town to be damaged beyond repair or that is not in conformance with the Standards and Specifications will be rejected.

6.10 FINAL CLEANUP

All surplus materials furnished by the Contractor and all tools and temporary structures shall be removed from the site by the Contractor, all debris and rubbish caused by the operations of the Contractor shall be removed, and the areas occupied during operations shall be restored to its original condition unless otherwise directed by the Town. All surplus materials furnished by the Town of

Wellington and delivered to the site by the Contractor shall be removed by the Contractor and delivered to a site designated by the Town. All surplus supplies furnished and delivered by the Town shall be removed by the Town.

6.11 RECLAMATION

Areas disturbed by construction shall be revegetated by seeding and mulch after more than 30-days of inactivity.

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SECTION 01300

TRAFFIC IMPACT STUDY GUIDELINES

PART 1 INTRODUCTION

1.1 General

This section contains the policies and guidelines necessary for the preparation of Transportation Impact Studies (TIS) for development proposals within the Town of Wellington. The policies exist to ensure consistent and proper traffic planning and engineering practices when land use actions are being considered.

1.2 Applicant Responsibility

The responsibility for assessing the traffic impacts associated with an application for development approval rests with the Applicant. The Town of Wellington serves in a review capacity. The assessment of these impacts shall be contained within a TIS report prepared under the supervision of, and sealed by, a Licensed Professional Engineer in the State of Colorado with experience in traffic engineering and transportation planning/engineering.

For all State Highways within the study area, the Applicant shall meet the requirements of the Colorado Department of Transportation.

1.3 TIS Process Overview

A. Define TIS

1. Attend Scoping Meeting: Section 2.1.
2. Identify Level of Analysis: Section 2.2.

B. Define Study Parameters

1. Develop the project description: Section 3.1.
2. Determine which Analysis Horizons to use: Section 3.2.
3. Determine the limits of the study area: Section 3.3.
4. Determine the evaluation components for the applicable type of TIS: Section 3.4.

C. Evaluate Traffic Volume

1. Vehicular Traffic

- a. Existing Traffic
 - i Perform roadway traffic turning movement counts: **Section 4.1 A.**
 - ii Determine intersection level of service: **Section 4.1 B.**
- b. Background Traffic
 - i Determine short-range turning movement projections: **Section 4.2 A.**
 - ii Determine long-range volume projection: **Section 4.2B.**
- c. Project Generated Traffic
 - i Determine trip generation rate: **Section 4.3 A.**
 - ii Determine the trip distribution and assignment: **Section 4.3E/F.**

D. Conduct Project Impact Analysis

- 1. Vehicular Traffic
 - a. Identify the project impact on the evaluation elements for the selected type of TIS: **Section 5.1**
 - b. Evaluate each element under the following traffic conditions:
 - i Existing traffic conditions.
 - ii Future traffic conditions without the proposed development.
 - iii Future traffic conditions with proposed development.
 - c. Identify all significant negative impacts: **Section 5.1**

E. Determine Mitigation Measures

- 1. Vehicular Traffic: **Section 6**

F. Determine Study Recommendations.

Identify the improvements that are needed to achieve the required LOS for the proposed land use action and background traffic in each design year.

- 1. Vehicular Traffic

G. Present the Completed TIS

1. Submit the completed study to the Town of Wellington.
2. Revise and resubmit the TIS as necessary to address review comments provided to the applicant by the Town or its Engineer.

1.4 Listing of Attached TIS Worksheets

The worksheets listed below are included at the end of this chapter, as Attachments A and B.

A. Base Assumptions

Refer to Section 2.1 B - Meeting Setup and Content.

B. TIS Waiver Request Worksheet

Refer to Section 2.2 A - No TIS Required.

PART 2 REQUIREMENTS AND CRITERIA

2.1 Scoping Meeting

A. Purpose.

The purpose of the scoping meeting is to determine the parameters for the study of traffic impacts for a specific development project, and to document those parameters. The parameters determined in the scoping meeting represent general agreement between the Town and the consulting engineer, but they may not be all-inclusive. Wellington retains the right to require any additional information and / or analysis to complete an evaluation of the proposed development project.

B. Meeting Setup and Content.

The Applicant is required to contact the Town to arrange for a scoping meeting or phone call to discuss the TIS requirements and determine the base assumptions. The Applicant should bring a completed Transportation Impact Study Base Assumptions Form (included at the end of this section as Attachment "A") to the meeting and be prepared to discuss the following:

1. Previous TIS prepared for the site, if any;
2. Location of the site;
3. Proposed access and its relationship to adjacent properties and their existing/proposed access;

4. Preliminary estimates of the site's trip generation and trip distribution at build-out;
5. Identification of proposed year of build-out;
6. Trip adjustment factors proposed, if any;
7. Approved and proposed developments in the study area, and the associated committed roadway improvements;
8. Anticipated roadway improvements to be provided by the Applicant;
9. Phasing plan proposed;
10. Special analysis needs.

C. Results of Meeting

The Scoping Meeting shall conclude with the Town and Applicant in mutual agreement with regard to determining the level of detail and extent to which the TIS will need to address each of the following:

1. Study area for the impact analysis;
2. Other developments within the study area;
3. Existing intersection counts;
4. Intersections to be studied in detail;
5. Trip Distribution;
6. Background traffic volume forecasts; and
7. Special analysis needs. (Non traditional peak hour volumes for some uses, neighborhood impacts, access management plans, etc.)

D. Documentation after Meeting

The approved scoping meeting form and attachments shall be inserted into the TIS.

2.2 Levels of Analysis.

The following levels of analysis apply: (These categories are intended as guidelines and may be revised, when warranted, by the Town of Wellington and/or its Engineer.)

A. No TIS Required.

Upon submittal of a TIS Waiver Request Worksheet (Attachment “B”) by the Applicant and written acceptance by the Town’s Engineer, the TIS requirement may be waived if all of the criteria below are satisfied:

1. Vehicular Traffic

- a. The peak hour trip generation is less than 20 vph.
- b. There are no additional minor or major street intersections on major collectors, arterials, or State Highways;
- c. The increase in the number of vehicular trips for the proposed use does not exceed the trip generation from the existing use by more than 20 peak hour trips;
- d. Any change in the type of traffic to be generated (i.e. the addition of new truck traffic) does not adversely affect the traffic currently planned for and accommodated within, and adjacent to, the property;
- e. The scale or use of the proposed development or redevelopment is not likely to cause less than acceptable levels of service on the adjacent public streets, accesses, and intersections; and
- f. The proposed development or redevelopment is not in the vicinity of a street or intersection with a history of safety and/or accident problems.

B. Traffic Memorandum.

A Traffic Memorandum, in lieu of a more detailed study, may be considered if all the following requirements are met:

1. Vehicular Traffic

- a. The peak hour trip generation is between 21 and 50 vph.
- b. Any new access requests are for local streets or minor collector streets only.

C. Full TIS.

A Full TIS may be required if one or more of the following conditions occur:

1. Vehicular Traffic

- a. The site generated traffic exceeds 50 peak hour trips, or
- b. New high volume access is requested for an arterial or State Highway.

2.3 Revisions and Updates

A revision or update to an approved TIS may be required when a previously approved land use action proposes an expansion, a change to access, or a change in use where new trip generation estimates exceed the original trip-end generation estimates. If the currently approved study was prepared within the last three years, an amendment letter addressing the changes may be accepted. The letter must address: a) an estimate of site trip generation, b) existing site trip generation, and c) the differences between anticipated estimates and existing trip generation. If the original study is older than three years, an entirely new study may be required by the Town.

PART 3 STUDY PARAMETERS

3.1 Project Description.

A description of the proposed project will be prepared and include the type of land use and size of the proposed project (number of dwelling units or building square footage). Any proposed phasing will be discussed and the anticipated completion date established. A figure depicting the proposed site plan will also be included and the proposed vehicular access locations will be described.

3.2 Analysis Horizons.

Three study horizons are required for a Full TIS analysis: the existing (current), the short range (short range build-out) and the long range (20 year). It may be acceptable for the short range and long range horizons to be identical for some large projects.

A. Existing Horizon.

The intent of completing an analysis of the existing (current) study horizon is to establish a baseline of traffic conditions.

B. Short Range Horizon.

The intent of the short range planning horizon is to investigate the immediate impacts of the completed, proposed project on the existing roadway network. The short range analysis horizon is 5 years from the date of preparation of the TIS. If the project is proposed to occur over multiple phases, each phase shall be evaluated for impacts one year after the occupancy of that phase for the short range analysis.

C. Long Range Horizon.

The third planning horizon is the long range planning horizon. The intent of the long range planning horizon is to evaluate the implications of the fully developed proposed project on the long-range traffic conditions. This study

horizon is for the Town's use as an indicator of traffic for planning purposes and the determination of the necessary Right-of-Way.

3.3 Study Area

The limits of the transportation network study area shall be defined for all levels of TIS analysis. The limits of the transportation network to be studied shall be based on the size and extent of the application for development approval, the existing and future land uses, and traffic conditions on and near the site. The exact limits of the study area are to be based on good engineering judgment, and an understanding of existing and future land use and traffic conditions at and around the site. The limits of the study area shall be agreed upon at the Scoping Meeting.

The concerns related to specific land use actions on specific studies vary greatly, but at a minimum, the factors to be considered for the establishment of the limits of the study area should include:

A. Full TIS

1. All adjacent streets, intersections, and access points;
2. Nearest offsite major intersection(s);
3. Internal public roads, including establishing the road classification;
4. Any pedestrian routes within one (1) mile of a school (residential land uses only).

B. Traffic Memorandum

1. All adjacent streets, intersections, and access points;
2. Internal public roads, including establishing the road classification;

3.4 Evaluation Elements

A. Full TIS.

The key elements of the project impact assessment for a Full TIS shall include the following evaluations:

1. Conformity with any adopted Transportation Master Plan and/or any access plans.
2. Peak hour intersection and driveway level of service: See **Table 1-1**;
3. Appropriateness of access locations;

4. Location and requirements for turn lanes or acceleration/deceleration lanes at accesses or intersections, including recommendations for taper lengths, storage length, acceleration/deceleration lengths, and other geometric design requirements per Wellington or CDOT requirements;
5. Sight distance evaluations and recommendations (intersection);
6. Multi-modal and TDM opportunities (if applicable);
7. Recommended traffic control devices for intersections which may include two way stop control, four way stop control or yield signs, school flashers, school crossing guards, crosswalks, traffic signals or roundabouts.
8. Traffic signal and stop sign warrants.
9. Progression analysis for signalized intersections (if applicable).
10. Safety and accident analysis.
11. Other items as requested by the Town and/or it's Engineer and agreed to in the Scoping Meeting.

B. Traffic Memorandum.

At a minimum, the following issues should be considered for submittal in a Traffic Memorandum:

1. No Long Range Horizon is required as part of this study.
2. Peak hour driveway level of service: see **Table 1-1**;
3. Appropriateness of access locations;
4. Location and requirements for turn lanes or acceleration/deceleration lanes at the access, including recommendations for taper lengths, storage length, acceleration/deceleration lengths, and other geometric design requirements per Wellington or CDOT requirements;
5. Sight distance evaluations and recommendations (intersection);
6. Appropriateness of the existing roadway signing and striping.
7. Other items as requested by the Town and/or it's Engineer and agreed to in consultation with the Applicant's Traffic Engineer.

PART 4 TRAFFIC VOLUMES

4.1 Existing Traffic

A. Roadway Traffic Volumes/Traffic Counts.

Current A.M. and P.M. peak hour traffic counts shall be obtained for the roadways within the study area for one, non-holiday Tuesday, Wednesday, or Thursday. Each peak hour count shall be conducted over a two hour period and shall include fifteen (15) minute count data to clearly identify the peak hours.

Weekend counts and/or average daily counts on local streets may also be required where appropriate when requested by the Town. Vehicle classification counts may be required.

In any case, these volumes shall be no more than one year old (from the date of application submittal). The source(s) of each of the existing traffic volumes shall be explicitly stated (CDOT counts, new counts by Applicant, Town counts, etc.) Summaries of current traffic counts shall be provided.

B. Intersection Level of Service.

A.M. and P.M. peak hour intersection levels of service shall be determined for the existing signalized and unsignalized intersections with collectors and arterials within the transportation network to be studied. Locations to be analyzed will normally be set in the “Scoping Meeting.” The analysis shall use procedures described in the latest edition of the **Highway Capacity Manual**. Factors for intersections will be by approach and those used for roadways will be by facility unless otherwise directed by Wellington.

1. Existing and Short Range Horizon. Use calculated peak hour factors or 0.85, whichever is higher.
2. Long Range Horizon. A peak hour factor of 0.95 may be used for the Long Range Horizon. Greater values may be used if approved by the Town.

4.2 Background Traffic

A. Short Range Volume Projections.

The traffic forecast for the short range planning horizon shall be the sum of existing traffic volumes plus cumulative development traffic from approved land use actions, plus background growth (as adjusted to avoid duplicative consideration of the identified development traffic from the approved land uses already considered).

The short range planning horizon background traffic growth rate shall be based on a growth rate from the Scoping Meeting based on one of the following methodologies:

1. CDOT rates, or

2. Historical traffic counts projected to the build-out year (at least three years of traffic data should be used for this), or
3. Area-wide traffic count analysis which considers traffic volume trends in the study area's circulation system and uses proportion/extrapolation methods.

B. Long Range Volume Projection

1. CDOT rates, or
2. Historical traffic counts projected to the build-out year (at least three years of traffic data should be used for this), or
3. Area-wide traffic count analysis which considers traffic volume trends in the study area's circulation system and uses proportion/extrapolation methods.

4.3 Project Traffic

A. Trip Generation Rate.

Trip generation should be calculated from the latest data contained within the Institute of Transportation Engineers' Trip Generation Manual. Other industry publications (such as the ITE Journal or other sources) may be approved by Wellington. When data is not available for a proposed land use or a modification is proposed, the Applicant must conduct a local trip generation study following procedures prescribed in the ITE Trip Generation Manual and provide sufficient justification for the proposed generation rate. This rate must be approved by the Town prior to its use in the written study.

B. Preliminary Land Use Assumptions.

The trip generation values contained in studies submitted prior to the establishment of a site-specific development plan shall be based on the maximum number of dwelling units permitted for the approved land uses, and/or the maximum trip generation rates for the non-resident development proposed land use action. When a TIS is being developed for a project with an established site-specific development plan, trip generation shall be based on actual dwelling unit counts and square footage(s) proposed on the final plan.

C. Trip Generation Table.

The Applicant shall prepare a Trip Generation Table, listing each type of land use within the site at build-out, the size and unit of measure for each land use, trip generation rates (total daily traffic, A.M. and P.M. peaks), directional splits for each in/out driveway, the resultant total trips generated. The data source shall be stated (state ITE land use code, if used). Build-out land uses

and trip generation shall be used for both the short range and long range planning horizons.

D. Adjustments to Trip Generation.

Trip-making reduction factors may be used after first generating trips at full ITE rates or pre-approved rates from other professional sources. Two specific situations will be closely reviewed. The first is when the traffic study assumes rates where the collection of mixed uses, such as at a shopping center, result in lower peak hour trips than when applying individual rates to each land use. The second is when reductions in the trip generation rates are assumed based on reductions due to travel demand management

1. Pass-by Trips. This first category may be considered when trips to the proposed development currently exist as part of the background traffic stream, referred to as a pass-by trip. Pass-by percentages identified in the ITE Trip Generation report or other industry publications will be considered with appropriate explanation and documentation. Pass-by traffic must remain assigned to driveways and access points. They are not additive to the background traffic stream. A technical appendix, table or map that illustrates the re-diversion of pass-by trips is required.
2. Internal Site Trips/TDM. Analytic support documentation of internal site trips and TDM (Transportation Demand Management) actions shall be provided to show how trip adjustments are derived. Optimistic assumptions regarding TDM actions will not be accepted unless accompanied by specific implementation proposals that will become a condition of approval. Such implementation proposals must have a high expectation of realization within a 5-year period after project initiation.

E. Trip Distribution.

Trip distribution must be documented in the TIS. It may be based on the professional engineer's judgment applied to one or more of the following: regional traffic volume projections, gravity model, market analysis, existing traffic flows, or applied census data. Regardless of the basis of the estimates, the procedures and rationale used in determining the trip distributions must be fully explained and documented.

F. Trip Assignment.

The project traffic will be assigned to the roadway system according to the trip distribution established above. The resulting project site generated traffic and total site traffic will be depicted on figures for each analysis horizon. These figures will include peak hour traffic volume information.

4.4 Total Traffic

The total traffic projections will be determined for each of the analysis horizons identified earlier in the base assumptions. The total traffic projections will include the existing traffic, plus the future background traffic, plus the project generated traffic. Based upon the total traffic projections and Wellington’s street standards and Transportation Master Plan (if applicable), the Applicant shall provide roadway functional classification recommendations.

PART 5 PROJECT IMPACTS

5.1 Significant Negative Impacts

This section applies primarily to vehicular related impacts associated with the proposed project. A project is defined as significantly impacting a study intersection when one of the following criteria is satisfied:

- A. For Signalized Intersections.**
 1. When the added project traffic causes an intersection to fail the minimum acceptable level of service standard; or
 2. When the background traffic conditions (without project traffic) causes an intersection to fail the minimum acceptable level of service standards; and when the project traffic causes more than a 2 percent increase in the intersection delay.
- B. For Unsignalized Intersections.**
 1. When back stacking to adjacent intersections would create impeded traffic flows and/or excessive congestion; or
 2. When added project traffic is determined to create potential safety problems.
 3. For Local Residential Streets:

Projected Avg. Daily Traffic	
<u>With Project (Total ADT)</u>	<u>Project Related Increase In ADT</u>
Up to 2,000	12 percent or more of Total ADT
2,000	10 percent or more of Total ADT

5.2 Project Impact Assessment.

The key elements of the project impact assessment include evaluations of issues outlined for a specific Analysis Level. Refer to **Section 1.3.4** for a listing of the Evaluation Elements.

A. Motor Vehicle Impact Evaluations

1. Intersection Delay

- a. An A.M. and P.M. peak hour intersection level of service analysis shall be conducted for each intersection analyzed in the TIS, based on procedures specified in the most recent release of the Highway Capacity Manual.
- b. The principal objective of the intersection level of service traffic impact analysis is to identify whether the traffic from the proposed project when added to the short range planning horizon traffic will result in a significant impact and an unacceptable level of service. For definition purposes, the thresholds for acceptable level of service are as shown in Table 1-1. All intersection components shall meet the following requirements:

**Table 1-1
Motor Vehicle LOS Standards (Intersections)**

Intersection Component	Major Intersection ¹	Minor Intersection ²	Driveway
Overall	LOS C	LOS C	No Limit
Any Leg	LOS D	LOS D	No Limit
Any Movement	LOS E	LOS E	No Limit
¹ Includes all signalized and unsignalized arterial/arterial and arterial/major collector intersections. ² Includes all unsignalized intersections (except major intersections) and high volume driveways ³ There are no LOS standards for the I-25 Interchange.			

- 2. Driveway Access. The design, number, and location of access points to collector and arterial roadways must be submitted for approval by the Town of Wellington. State Highway accesses require the issuance of an Access Permit from CDOT. The number of access points must be kept to a minimum and be designed to be consistent with the type of roadway

facility. Access points will be reviewed and approved by the Town based on the following information:

- a. Access location(s) as shown on the site plan.
- b. Proposed traffic turning movements.
- c. Analysis of on site (driveway) stacking/queuing and impacts to adjacent streets.
- d. Signalization requirements and design in accordance with these guidelines.
- e. Geometric design of the access and proposed improvements to Wellington facilities in accordance with ITE, AASHTO, CDOT, NCHRP or other nationally accepted design standards.
- f. Compliance with the CDOT State Highway Access Code and any adopted access management plans if access is requested to a State Highway.

3. Traffic Signals.

- a. Proposed and existing access points, proposed intersections, and existing intersections effected by the land use actions being analyzed in the report that have any potential for signalization will be reviewed and discussed during the scoping meeting. Discussion will include review of existing signals/potential modifications, proposed signals, school signals for school crossings, school flashers, pedestrian signals/crossings, and any other potential for signal devices and signal interconnect issues.
- b. During the Scoping Meeting an outline of locations for signal warrant analysis will be agreed upon. Generally, most traffic signal locations have been predetermined by the Town.
- c. Signal Warrant Analysis for potential signal locations shall consist of a review of the applicable signal warrants contained in the Manual on Uniform Traffic Control Devices.

- d. If any location proposed for signalization is not spaced according to any applicable Transportation Master Plan or existing Town signal spacing policy, then a traffic signal progression analysis shall be required. The analysis limits, parameters (including allowable phasing, split times, walk timing, clearances and methods) to be used for the study will be discussed at the Scoping Meeting.
- e. Alternatives to signalization at potential signal locations will be discussed in the scoping meeting and the report. The alternatives to adding new intersections to be discussed should include no new intersection, limited movements, and roundabouts.

B. Special Studies.

This section provides the Town with opportunities to request specific focused traffic analyses that may be unique to the proposed land use action. The Applicant and the Town will determine if special studies are required in the Scoping Meeting. These may include, but are not limited to the following:

1. Access spacing,
2. Accident/safety concerns (accident statistics),
3. Truck routing,
4. Emergency and snow routes,
5. Hazardous material routes.
6. Neighborhood Transportation Impact Evaluation. The TIS may be required to include a focused analysis of the potential project related impacts on adjacent residential neighborhood quality of life issues such as potential cut-through traffic and speeding/volume concerns. If it is determined that a neighborhood transportation impact evaluation is required the following procedure should be followed:
 - a. Examine existing transportation conditions within the neighborhood. This should follow the same procedure as set forth earlier for the transportation impact analysis. Daily and peak hour traffic volumes should be collected for the local streets to be included in the analysis.
 - b. Determine project generated traffic for all modes within the neighborhood and show on a figure.

- c. Determine total traffic projections for the local streets. This should follow the same procedures as described earlier, including other projects and area wide growth if applicable.
 - d. Determine if the proposed project would create significant impacts to the residential streets using the criteria stated earlier.
 - e. If necessary, develop measures, including but not limited to traffic calming techniques, to mitigate any significant impacts.
 - f. The neighborhood TIS should also discuss how pedestrians and bicyclists would access the proposed project to/from the adjacent neighborhood(s), and the need for special facilities to enhance direct pedestrian and bicycle connectivity.
7. Sight Distance. Sight distance concerns that are anticipated or observed which may impact driveway, intersection, or roadway operation and safety need to be discussed in the TIS. Recommendations regarding stopping sight distance, and intersection sight distance should be provided by the Applicant's traffic engineer for detailing on the final development, site plan, or final construction plans.

PART 6 MITIGATION MEASURES

When a project's vehicular impacts are determined to not meet the minimum acceptable level of service standard, the TIS shall include feasible measures, which would mitigate the project's impacts. The mitigation measures are intended to be *in addition to* the minimum required improvements necessary to meet Wellington standards and codes.

6.1 Paving Threshold

The Town of Wellington requires a Paving Threshold Analysis for any proposed development or land use action that will impact unpaved or gravel roads. This analysis is required for any development proposal that will create more the two (2) new dwelling units or that is expected to generate more than twenty (20) new daily vehicles trips on an unpaved or gravel road in the traffic impact area. If the full buildout of the development will increase the average daily number of vehicles on an unpaved surface to exceed 200 vehicles per day, paving is required.

A. Geometric Improvements

Turn lanes and other auxiliary lane needs shall be identified for each access. Design basis shall generally be ITE, AASHTO, CDOT, NCHRP or other nationally accepted standards. All proposed project entrances streets shall be evaluated as to whether they require acceleration lanes or deceleration lanes as per NCHRP Report 279 (applicable sections reprinted in **Appendix A**). The

required length, including storage and taper of auxiliary lanes shall be per the Section 01040, and Figures 5-13 through 5-15.

All proposed geometric improvements (auxiliary lanes) on a State Highway shall be per the current Colorado Department of Transportation State Highway Access Code.

6.2 Traffic Signal Operations Improvements.

Traffic Signal Operational improvements would include upgrading signal to include additional signal phases and/or, signalization of an unsignalized intersection. Signalization of project access drives would not be considered as a mitigation measure. The Town and/or its Engineer must approve signal improvements and/or installations.

6.3 Street Widening and Other Physical Improvements

Mitigation measures, which include street widening, and other physical improvements must be demonstrated to be physically feasible and must meet minimum Town standards and codes for both on-site and off-site improvements.

6.4 Street Restriping and Parking Regulations

The Town must approve proposed striping and parking regulation mitigation(s). Generally, street restriping is not a preferred mitigation measure because it often requires parking regulations, which may cause secondary impacts in certain commercial and residential areas. Therefore, any parking impacts should be clearly identified and proposed for mitigation to the extent feasible.

6.5 Transportation Demand Management (TDM) Measures

Transportation Demand Management measures are designed to facilitate the use of alternate transportation modes in an effort to decrease demand on the roadway system by single occupant vehicles. A detailed description of the proposed TDM measures and implementation plan must be included in the TIS for any project seeking TDM-related trip reductions. If the TDM program is acceptable to the town of Wellington, the applicant will be allowed to reduce total project vehicle trips by an amount commensurate with applicable trip reduction policies.

A. Examples of TDM measures

1. Vehicle trip reduction incentives and services offered by employers to encourage employees to utilize alternative modes of travel such as carpooling, bicycling, walking, telecommuting, etc.
2. Vehicle trip reduction incentives and services affecting visitors to the project, such as shoppers, clients, patrons, etc.

3. Provision of a mix of land uses in close proximity, facilitating trip making by walking, bicycling, or local shuttles.
4. Provision of on-site facilities that encourage the use of alternate forms of transportation, such as bicycle lanes and amenities, enhanced pedestrian connections, telecommuting facilities, etc.

PART 7 REPORT CONCLUSIONS

7.1 Recommended Improvements

The findings of the Transportation Impact Study should be provided in summary format, including the identification of any areas of significant impacts and recommended improvements/mitigation measures to achieve the LOS standards.

A. Geometric Improvements.

The TIS shall include recommendations for all geometric improvements such as pavement markings, signs, adding through or turn lanes, adding project access and assorted turn lanes, acceleration lanes, and medians. Sufficient dimensions/data shall be identified to facilitate review. Anticipated right-of-way needs shall also be identified.

B. Responsibility.

The Applicant shall describe the location, nature, and extent of all transportation improvements that the Applicant recommends to achieve the required Level of Service for each analysis horizon's year. In addition, the party (ies) responsible to complete the improvements shall be identified. For this discussion, the following definitions apply:

1. Master Planned. Improvements planned having committed funding, including those identified in short range capital improvement programs by the Town of Wellington, Larimer County, a special district, CDOT or other agency. These may be identified in the Scoping Meeting. The Town will provide this information to the Applicant.
2. Background Committed. Improvements committed to by a previously approved development as identified in the Scoping Meeting.
3. Applicant Committed.

C. Proposed Transportation Demand Management.

If TDM measures are recommended to mitigate the traffic impact of the proposed land use action, a specific TDM Implementation Proposal shall be developed and presented to the Town. If accepted, this Implementation Proposal will become a condition of approval of the land use action requested.

D. Summary Presentation.

The Applicant shall submit a Recommended Improvements Summary to present the recommendations. The recommended improvements shall be categorized as Master planned, Background Committed, or Applicant Committed. Each project should include a description of its location, the type of project, right-of-way needs (for roadways), and signal or turn lane improvements (for intersections). Commitment to funding and constructing the improvements should be identified, either by local governments, districts, or by the Applicant.

Attachment A
Transportation Impact Study
Base Assumptions

Project Information			
Project Name			
Project Location			
TIS Assumptions			
Type of Study	Full:	Memo:	
Study Area Boundaries	North:	South:	
	East:	West:	
Study Years	Short Range:	Long Range:	
Future Traffic Growth Rate			
Study Intersections	1. All access drives	5.	
	2.	6.	
	3.	7.	
	4.	8.	
Time Period for Study	AM: 7:00-9:00	PM: 4:00-6:00	Sat Noon:
Trip Generation Rates			
Trip Adjustment Factors	Passby:	Captive Market:	
Overall Trip Distribution	SEE ATTACHED		
Mode Split Assumptions			
Committed Roadway Improvements			
Other Traffic Studies			
Areas Requiring Special Study			

Date: _____

Traffic Engineer: _____

Wellington Town Administrator or Engineer: _____

Attachment B
TIS Waiver Request - Worksheet

This form must be completed and submitted when requesting a waiver of the TIS submittal and compliance requirements. This form is not required with building permit applications for residential projects proposing twelve dwelling units or less and no substantial access changes on a collector or arterial roadway.

Project Name: _____ Developer: _____
Date: _____ By: _____
Property Legal Description (lot, block, Title: _____
Subdivision) _____ Address: _____
_____ Phone #: _____
_____ Fax #: _____
_____ Email: _____

NON-RESIDENTIAL DEVELOPMENT:

Provide the following information for all non-residential projects:

A. Existing use:

1. Description of existing land use: (if none, proceed with Proposed Use) _____

2. Existing building area (square footage) for above use(s): (2) _____
3. Number of employees on site each day: (3) _____
4. Daily trip ends for employees [mult. line (3) by the number 4]: (4) _____
5. Number of customers on site each day: (5) _____
6. Daily trip ends for customers [multiply line (5) by the number 2] (6) _____
7. Number of venders on site each day (include trash, ups, etc.): (7) _____
8. Daily Trip Ends for venders [mult. line (7) by the number 2]: (8) _____
9. Total Vehicular Daily Trip Ends [line (4) plus line (6) plus line (8)]: (9) _____
10. Source of trip generation data (circle one): ITE, business records, traffic engineer,

personal estimate, other: **Attach documentation to support your data.**

11. Number of accesses existing onto the public street(s) from this property: _____

B. Proposed use:

1. Description of proposed land use: _____

2. Proposed building area (square footage) for above use(s): (2) _____

3. Anticipate number of employees on site each day: (3) _____

4. Daily Trip Ends for employees [multiply line (3) by the number 4]: (4) _____

5. Anticipate number of customers on site each day: (5) _____

6. Daily trip ends for customers [multiply line (5) by the number 2]: (6) _____

7. Anticipate number of vendors on site each day: (7) _____

8. Daily Trip Ends for vendors [multiply line (7) by the number 2]: (8) _____

9. Total Daily Trip Ends [line (4) plus line (6) plus line (8)]: _____

10. Source of trip generation data (circle one): ITE, business records, traffic engineer, personal estimate, other: **Attach documentation to support your data.**

11. Proposed number of accesses onto the public street(s) from this property (does NOT include any existing accesses proposed to remain for use): _____

11. Number of existing accesses proposed to remain and be used: _____

If the total trip new trips, (that is the difference between the daily trip ends calculation for any existing use and the total daily trip ends calculated for the proposed use), is less than 200 and if peak hour and/or daily traffic counts demonstrate that the existing traffic plus the site generated traffic volumes are within the limits set by City Street Standards, the applicant may request a waiver of the Traffic Impact Study submittal requirements by signing below.

Signature

Date

Full TIS Required: _____ Memo TIS Required: _____ TIS Waived: _____

By: _____

Date: _____

RESIDENTIAL DEVELOPMENT:

The following residential development projects require a Traffic Memo or full Traffic Impact Study.

1. Any application proposing more than 20 single family detached dwelling units.
2. Any application proposing more than 24 multi-family dwelling units where dwelling units are within duplex, triplex, or four-plex structures.
3. Any application proposing more than 34 multi-family dwelling units where dwelling units are within structures containing five or more units.
4. Any application proposing a substantial access change onto a major collector or arterial roadway.

Fill out the table below and indicate in the table the number of dwelling units or access changes proposed for the type(s) of residential development included in your development. If the number of dwelling units and changes in access are less than the thresholds established above and if peak hour and/or daily traffic counts demonstrate that the existing traffic plus the site generated traffic volumes are within the limits set by City policy, the applicant may request a waiver from the TIS requirement by signing your name below.

NUMBER	RESIDENTIAL DEVELOPMENT TYPE
	Single family detached/dwelling units
	Multi-family dwelling units in duplex, triplex, or four-plex structures
	Multi-family dwelling units in structures containing five or more units
	Access changes onto a collector or arterial roadway

Signature

Date

Full TIS Required: _____ Intermediate TIS Required: _____ TIS Waived: _____ By: _____ Date: _____
--

APPENDIX A

WARRANTS/ GUIDELINES FOR LEFT TURN AUXILIARY LANES WARRANTS/ GUIDELINES FOR RIGHT TURN AUXILIARY LANES

Source: National Cooperative Highway Research Program

Report 279 – Intersection Channelization Design Guide

Transportation Research Board

PART 8 WARRANTS AND GUIDELINES FOR USE OF LEFT TURN LANES

8.1 New Construction – Signalized Intersections

Left-turn lanes should be considered at the planning and preliminary design stages of any new signalized intersection. Special efforts should be made to include separate left turn lanes because of their many advantages which include their:

- Proven safety effectiveness
- Effectiveness in improving intersection capacity
- Flexibility in possible signal phasing schemes
- Understand of operation by the driving public.

Signalized capacity analysis procedures should be used to determine lane arrangements. Because of the many variables involved, it is not feasible to

develop guidelines for all conditions. However, the following general rules of thumb are useful in evaluating left turn lane needs at specific locations.

Separate treatment of left turns will be required if:

1. left turn design volume exceeds 20 % of total approach volumes; or
2. left turn design volume exceeds 100 vehicles per hour in peak periods.

Left turn lanes may also be considered based on approach geometrics. If more than minimum stopping sight distance is not available to the intersection, it may be appropriate to include left turn lanes regardless of demand volume.

8.2 New Construction – Unsignalized Intersections

Streets and highways with unsignalized intersections also may require left turn lanes to facilitate traffic flow. The following guidelines are suggested:

- A.** Left turn lanes should be considered at all median crossovers on divided, high speed highways;
- B.** Left turn lanes should be provided at all unstopped (i.e. through) approaches of primary, high-speed rural highway intersections with other arterial or collections
- C.** Left turn lanes are recommended at approaches in intersections for which the combination of through, left, and opposing volumes exceeds the warrants shown in Figure 4-12. (Taken from Report 279 – and altered to include only radius turns and full turn lanes. Taper lanes have been eliminated and included as full turn requirements.)
- D.** Left turn lanes on stopped or secondary approaches should be provided based on analysis of the capacity and operation of the unsignalized intersection. Considerations include minimalizing delays to right turning or through vehicles, and total approach capacity.

8.3 Reconstruction and Rehabilitation

Addition of left turn lanes at existing intersections should be considered if safety or capacity problems occur, or if land use changes are expected to produce significant shifts in local traffic patterns (such as increases in left turn demand).

The traffic volume guidelines described for new intersections are also appropriate for evaluating the need for left turn lanes at existing intersections.

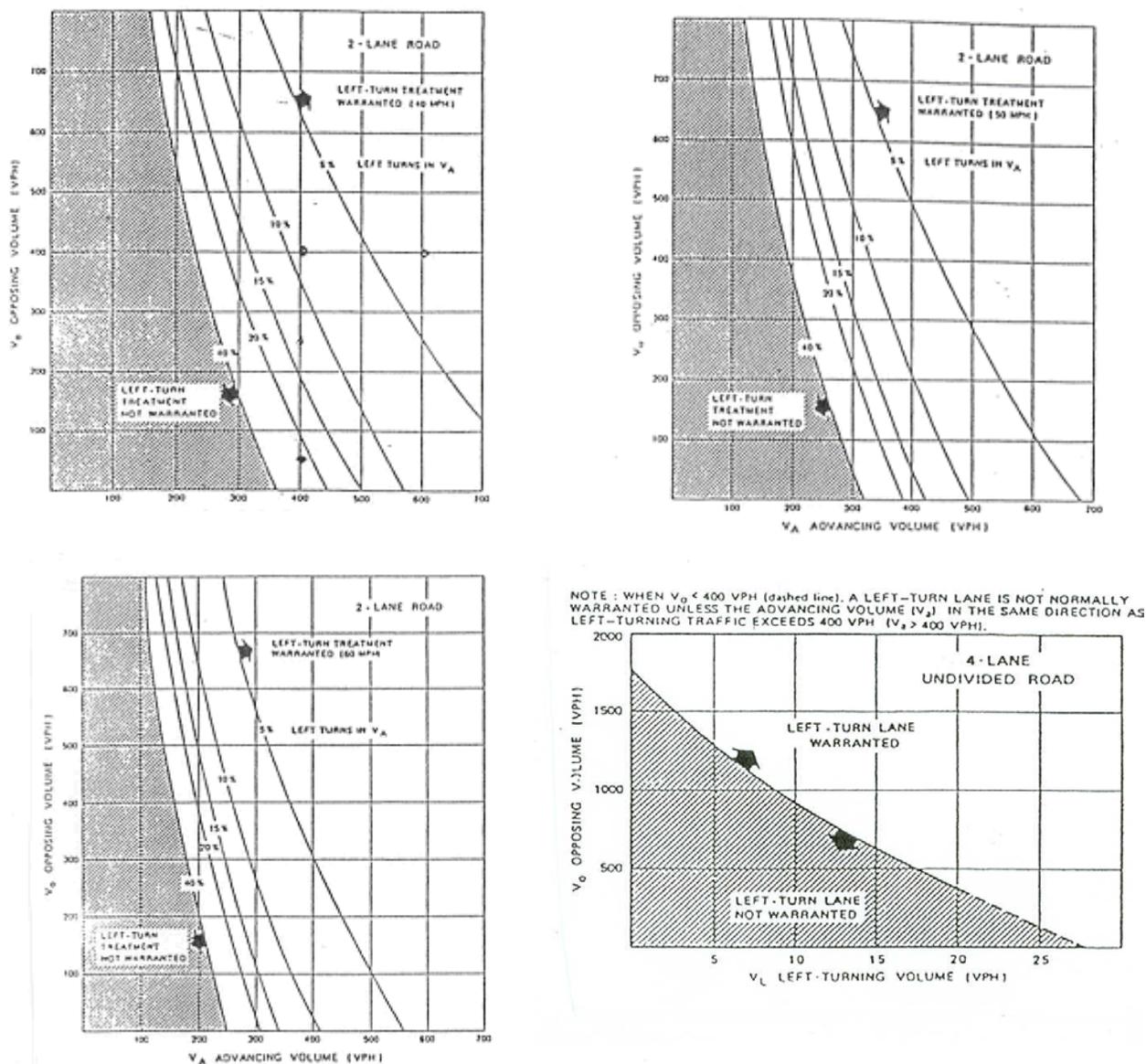


Figure 4-12. Volume warrants for left-turn lanes at unsignalized intersections. (Source: Ref.)

PART 9 WARRANTS AND GUIDELINES FOR USE OF RIGHT TURN LANES

Provision for right turn lanes exclusive of through lanes should depend on traffic volumes, available room for the additional lane, and capacity considerations. At urban intersections, the following factors may contribute to the need for a right turn lane:

- Significant percentage of approach volumes as right turning volume
- Presence of pedestrians who would conflict with right turning vehicles
- Severe skew of grade that increases the difficulty of right turns.

For 2 lane highways, volume warrants for right turns are generally much lower. This is because right and through vehicles are restricted to a single lane. Figure 4-23 can be consulted to provide guidance for including right turn lanes. (Taken from Report 279 – and altered to include only radius turns and full turn lanes. Taper lanes have been eliminated and included as full turn requirements.)

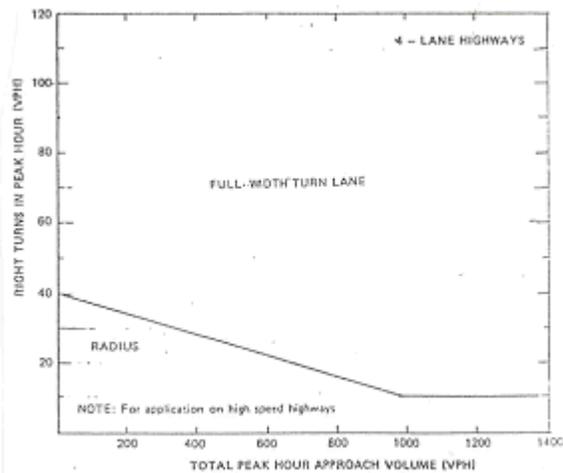
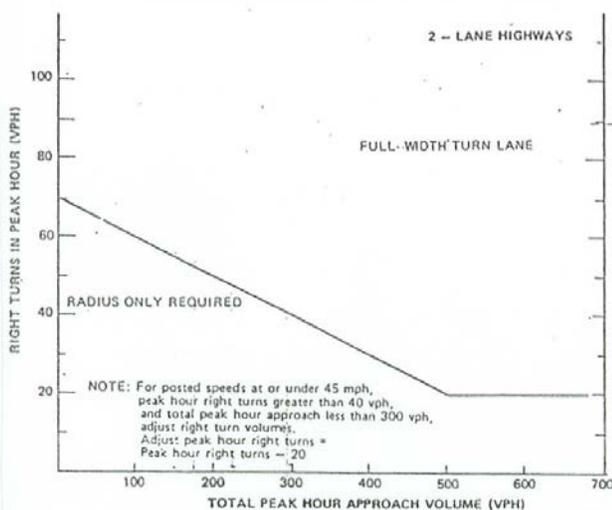


Figure 4-23. Traffic volume guidelines for design of right-turn lanes. (Source: Ref. 4-17)

Brief Explanation of Levels of Service (LOS)

The acceptability of the impact of a proposed development substantially hinges on the level of service analysis completed by the traffic engineer and discussed within the Traffic Impact Study. The following information provides some background material explaining the level of service analysis:

A Level of Service analysis is based upon procedures outlined in the Highway Capacity Manual (HCM 2000) published by the Transportation Research Board (TRB). This type of analysis assigns a letter value to an intersection, approach or movement based on average delay experienced by vehicles utilizing that intersection, approach or movement. The letter values assigned range from A (the best) to F (the worst). A summary table that includes the definition of different LOS is provided below for signalized and unsignalized intersections.

Signalized Intersection		Unsignalized Intersection		Definition
LOS	Delay (sec/veh)	LOS	Delay (sec/veh)	
A	≤10.0	A	≤10.0	Favorable progression
B	>10.0 and ≤ 20.0	B	>10.0 and ≤ 15.0	Good progression
C	>20.0 and ≤ 35.0	C	>20.0 and ≤ 25.0	Fair progression
D	>35.0 and ≤ 55.0	D	>35.0 and ≤ 35.0	Noticeable congestion
E	>55.0 and ≤ 80.0	E	>55.0 and ≤ 50.0	Limit of acceptable delay
F	>80	F	>50	Approaching Unacceptable

Source: *Highway Capacity Manual*, Transportation Research Board, 2000

The acceptable delays between signalized and unsignalized intersections are different for like levels of service because drivers generally have a different expectation of delay at the two intersections. Drivers approaching a red light expect to be delayed. Drivers approaching a stop sign expect to stop and then move on.

In larger urban areas, it is standard engineering practice to assume that a facility with LOS A through LOS D is within an acceptable range for most users. In some instances (Loveland for example) LOS C is required for acceptability, while in other large communities, LOS E for an overall intersection and even LOS F for some movements is determined to be acceptable.

* * * END OF SECTION * * *

SECTION 01720

PROJECT RECORD DOCUMENTS

PART 1 GENERAL

1.1 DESCRIPTION

- A. This section covers Project Record Drawings. Developer is responsible for completed project record documents.

1.2 MAINTENANCE OF DOCUMENTS AND SAMPLES

- A. Store record documents apart from documents used for construction.
- B. Maintain documents and samples in a clean, dry, legible condition and in good order. Do not use record documents for construction purposes.

1.3 RECORDING

- A. Project Record Drawings shall be provided to the Town by the project Design Engineer prior to Construction Acceptance.
- B. Label each document "DRAWINGS OF RECORD" or "RECORD DRAWINGS" in neat large printed letters.
- C. Record information concurrently with construction progress.
 - 1. Do not cover Work until required information is recorded.
- D. Marking of Project Records.
 - 1. Legible and with a dark pen.
 - 2. Ink shall not be water based or subject to easy smearing.
- E. Mark Drawings to record actual construction.
 - 1. Field dimensions, elevations, and details.
 - 2. Changes made by a modification.
 - 3. Details not on original Drawings.
 - 4. Horizontal and vertical locations of underground utilities and appurtenances, using coordinates

5. Depths of various elements in relation to project datum.
6. Location of sewer and raw and potable water services and taps.

1.4 SUBMISSION

A. Accompany submittal with transmittal letter containing:

1. Date.
2. Project title and number.
3. Contractor's name, address, and telephone number.
4. Title and number of each Record Document.
5. The signature of the Design Engineer, and his Professional Engineering Stamp.

B. Project Record Drawings will be submitted on 22"x34", 3 mil (minimum) reproducible, double-matte Mylar and electronic copies in pdf and CAD format.

1. The Construction Acceptance of the project will not be made until the Project Record Drawings are received and accepted by the Town.

PART 2 PRODUCTS

A. Section not used.

PART 3 EXECUTION

A. Section not used.

* * * END OF SECTION * * *

**DIVISION 2 –
WATER UTILITY**

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DRAWING DETAIL EXHIBITS

Division 2 –Water Utility Exhibits

- 2-1 Bedding Detail for PVC Distribution Pipe
- 2-2 Thrust Block Detail
- 2-3 Replacing Asphaltic Concrete Pavement –Water Main Trench
- 2-4 Standard Air and Vacuum Relief Valve
- 2-5 Water Service Connection (Typical 3/4-in and 1-in)
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- 2-8 Fire Hydrant Detail
- 2-9 Waterline Crossing Detail
- 2-10 Waterway Crossing Detail
- 2-11 Valve Box Cover with Concrete Collar **(new 2015)**
- 2-12 Fire Line Detail **(new 2015)**
- 2-13 Replacing Asphaltic Concrete Pavement –Narrow Water Service Trench **(new 2015)**
- 2-14 Bedding Detail – Type K Water Service **(new 2015)**

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SECTION 01005

APPROVED PRODUCT LISTING – WATER DISTRIBUTION

PART 1 PART 1 - GENERAL

1.1 DESCRIPTION:

- A.** This section lists the required manufacturers and/or products referred to in the related sections of the standard construction specification.

PART 2 PART 2 - SECTION 02224 PIPE BORING AND JACKING

A. CASING SEALS

1. Pipeline Seal and Insulator Co., Model W.
2. Or Town approved equal.

B. CASING CHOCKS

1. Cascade Waterworks.
2. Power Seal
3. Or Town approved equal.

PART 3 SECTION 02615 DUCTILE IRON PIPE

A. MECHANICAL JOINTS RESTRAINTS:

1. Megalug Series 1100, manufactured by EBAA Iron, Inc
2. GripRing, manufactured by Romac Industries, Inc
3. Uniflange Series 1400, manufactured by Ford Meter Box Co., Inc.

B. PUSH-ON JOINTS RESTRAINTS:

1. Megalug Series 1700, by EBAA Iron, Inc
2. Uniflange Series UFR 1390-C, manufactured by Ford Meter Box Co., Inc
3. Romac 600 Series Style 611 manufactured by Romac Industries, Inc.

PART 4 SECTION 02621 PLASTIC PRESSURE PIPE

A. TRACER WIRE SPLICES:

1. Copper: #12 stranded, water-tight insulation for direct bury

B. LOCATOR STATION BOXES WITH LID LABELED “LOCATOR STATION”:

1. Equal to cathodic protection test station termination box
2. Tyler 6855 Series
3. East Jordan Iron Works (EJIW) 8555 Series
4. Or Town approved equal

C. MECHANICAL JOINTS RESTRAINTS:

1. Megalug Series 2000PV or Series 2000SV, manufactured by EBAA Iron Inc
2. PVC Ring Lock Series 3500, manufactured by Star Pipe Products, L.P.
3. Uniflange Series 1500, manufactured by Ford Meter Box Co., Inc.

D. PUSH-ON JOINTS RESTRAINTS:

1. Megalug Series 1600 with Type 304 stainless steel tie bolts, manufactured by EBAA Iron Inc.
2. Uniflange Series UFR1390-C with Type 304 stainless steel tee bolts, manufactured by Ford Meter Box Co., Inc.
3. Romac 600 Series Style 611 with Type 304 stainless steel tee bolts, manufactured by Romac Industries, Inc.

PART 5 SECTION 02641 VALVES

A. GATE VALVES:

1. Mueller
2. American Flow Control
3. Clow
4. M & H Valve Company

5. US Pipe.

B. BUTTERFLY VALVES:

1. Mueller
2. Pratt
3. American Darling (Val-Matic)
4. DeZurick
5. M & H Valve Company.

C. VALVE BOXES:

1. Tyler 6860 series
2. AIR RELIEF/VACUUM RELIEF VALVES:
3. Crispin Universal Air Valve, by Multiplex Manufacturing
4. Apco Combination Air Release Valve, by Valve and Primer Corporation
5. CAV Combination Air Release and Vacuum Valve, G.A. Industries Inc
6. Or Town approved equal.

PART 6 SECTION 02644 FIRE HYDRANTS

A. FIRE HYDRANTS:

1. Waterous by American Flow Control, Pacer Model, Traffic Model WB67-250
2. Or Town approved equal

PART 7 SERVICE LINES, METERS AND APPURTENANCES

A. Water Service Pipe

1. Reference detail 2-5

B. TAPPING SADDLES:

1. Ford.
2. Or Town approved equal

C. CORPORATION STOPS

1. Ford
2. Or Town approved equal

D. COUPLINGS

1. Ford
2. Or Town approved equal

E. CURB STOPS

1. Ford, Mueller, or
2. A-Y McDonalds compression type only or
3. As Town approved equal.

F. CURB BOXES FOR CURB STOPS

1. Mueller; top threads adjustable height
2. Or Town approved equal

G. METERS AND STRAINERS

1. Schlumberger/Neptune.
2. Invensys/Sensus/Rockwell.
3. Badger.
4. Or Town approved equal

H. METER SETTERS

1. 5/8 x 3/4-inch copperhorns (interior meter settings):
 - a Ford
 - b Or Town approved equal
2. 5/8 x 3/4-inch copper setters (exterior meter settings):
 - a Ford
 - b Or Town approved equal

3. 1-inch copperhorns (interior meter settings):
 - a Ford
 - b Or Town approved equal
4. 1-inch copper setters (exterior meter settings):
 - a Ford
 - b Or Town approved equal
5. 1 ½-inch and 2-inch meter setters:
 - a Ford.
 - b Or Town approved equal

I. METER PITS

1. ¾-inch and 1-inch meter pits:
 - a Mid States Polyethylene,
 - b Or Town approved equal
2. Covers and lids for ¾-inch and 1-inch meter pits:
 - a Ford; #W3 cover with a WA3L-TP lid.
 - b Or Town approved equal
3. 3-inch extensions for ¾-inch and 1-inch meter pits:
 - a Mid States Polyethylene,
 - b Or Town approved equal

J. METER VAULTS

1. Meter vaults for 1 ½-inch and larger meters are:
 - a AMCOR Precast Concrete MH
 - b Or Town approved equal.
2. Meter pit and vault covers for 1 ½-inch and larger meters are:
 - a Casting Incorporated #MH-125-24 AL-WATER.

b Or Town approved equal.

K. BACKFLOW PREVENTERS

1. FEBCO
2. Or Town approved equal.

END OF SECTION

SECTION 01010
WATER SYSTEM DESIGN CRITERIA

PART 1 MINIMUM DESIGN CRITERIA

1.1 GENERAL

- A. All water distribution and transmission systems will comply with these Standards and Specifications for potable water main and service lines. Additional criteria may be required by the Town.
- B. Use only those materials included in these specifications.

1.2 DESIGN CONDITIONS

A. Design Parameters

	Single Family	Multi-Family	Commercial /Industrial (3)
Min. Fire Flow (gpm) (2)	1000	1500	Refer to UFC 2013 under SF; justify flow rate
Max Main Static Pressure (psi)	80	80	80
Min. Allowed Dynamic Pressure (psi) (4)	45	45	45
Residual System Pressure During Fire Flow (psi)	20	20	20

Notes	
1	State of Colorado – Design Criteria for Potable Water Systems, September, 2013
2	Uniform Fire Code 2013 (UFC): Single Family (App III-A, 5.1), Multi-Family (Table A-III-A-1)
3	Submit design analysis in the Preliminary Information Report (ref: 01000, 4.1). For Commercial/Industrial developments, these data and fire protection design must be reviewed and approved by the Wellington Fire Protection District or other fire jurisdiction having the authority for the area to be served.
4	The minimum allowed dynamic pressure shall be met at Maximum Daily Flow demand

B. Water System Hydraulic Model

- 1. New development proposals shall provide model results and analysis using the Town’s computer model InfoWater v10.0 (or higher) by

Innovyze Inc. Contact the Town for access to this model or apply in writing for waiver from this requirement.

1.3 PIPE SIZES

- A. Minimum main line size shall be eight (8) inches in diameter. For pipe sizes larger than twelve (12) inches, the Town will determine the Specifications.
- B. All mains shall be looped, unless approved otherwise in writing by the Town.

1.4 SERVICE LINES

- A. Each structure and each subdivided lot shall be served by a separate service line. No compound services are allowed.
- B. Service lines shall be of a size which is adequate to supply the requirements of the property being served. The minimum size allowable for a service line shall be 3/4 inch. The requirements of the property being served shall be defined by peak demand, as calculated in the A.W.W.A. Manual of Water Supply Practices, entitled "Sizing Water Service Lines and Meters". Service line fittings shall be of like materials.
- C. Meter pits located beneath asphalt or concrete shall be constructed from standard precast concrete manhole sections. Meter pits located with landscaped areas shall be constructed of bituminous fibers.
- D. During Town inspection of water service connections, Contractor shall be present on-site with building permit.
- E. Service lines shall be marked with stamped 'W' in curb face as shown in water service connection detail (DWG. REF. 2-5). 'W' cut in curb face with a demolition saw or similar type saw will not be allowed.

1.5 DEPTH

- A. All water lines including hydrant leads and water services shall have at least four and one half (4.5) feet of ground cover from the top of the pipe to the finished ground surface.

1.6 ALIGNMENT

- A. All water lines shall be laid, when possible, ten (10) feet north or west of the center line of the street, from the point of beginning to where the line ends. Deflections in the alignment shall be made using fittings. Water and sewer lines shall be installed with a minimum ten (10) foot horizontal separation (edge to edge of pipe).

- B. Dead end lines shall be avoided if at all possible. If approved by the Town, the maximum length of a dead end line shall not be greater than 600 feet.

1.7 GRADE

- A. All pipe shall be laid and maintained to the design specified lines and grades. Fittings, valves, and hydrants shall be at the required locations with joints centered, and all valve and hydrant stems plumb. No deviation shall be made from the required line or grade except with the written consent of the Town. All pipe shall be laid to the depth shown on the contract drawings or as directed by the Town in writing. The depth shall be measured from the established street grade or finished surface level to the top of the pipe barrel.
- B. Air and vacuum valves are required at high points on water lines 12 inches and larger. Town may require air and vacuum valves on smaller lines if in their opinion they are necessary.

1.8 FUTURE CONNECTIONS

- A. When future main extensions are possible, the main must be valved such that only one valve will have to be closed when the main is extended. The valve must be restrained so that when the one valve is closed and the line to be extended is exposed, the valve will remain safely in place. Restraint may be made by the use of a swivel or restrained mechanical joint or lengths of pipe installed on the extension side of the valve designed by a professional engineer to develop sufficient restraint from the soil resistance.

1.9 VALVING

- A. Mainline valve placement.
 - 1. Place valves not more than 18 inches from any fitting.
 - 2. In line Tee connections shall not have less than two (2) valves, except hydrant Tees.
 - 3. In line connections where a cross is used, shall not have less than three (3) valves.
- B. Valves shall be the same size as the line for which they serve.
- C. Valves will be placed on lines of (12) twelve inch or smaller diameter no more than (500) five hundred feet apart. Each fire hydrant shall have a hydrant valve.

- D. For lines larger than 12" the valve location and spacing will be determined by the Town.
- E. The valving of the mainlines between hydrants must be accomplished to prevent more than one hydrant from being out of service in the event of a mainline break or shutdown.

1.10 BLOW OFF VALVE ASSEMBLY

- A. In all installations where the main will be permanently dead-ended, such as a cul-de-sac, a blow-off assembly or fire hydrant shall be installed. Where the main will be temporarily dead-ended, for example the boundary of a subdivision filing, a blow-off shall be installed, unless a fire hydrant, which can serve additionally as a blow-off, is located at the main's temporary end. All plugs and caps unless otherwise specified, shall be provided with a concrete thrust block, or thrust shall be restrained by attaching suitable metal tie rods or clamps as specified.
- B. Blow-off assembly sizing shall be dependent upon the size of line it is to be attached and will be sized on a case by case basis by the Design Engineer and approved by the Town.

1.11 FIRE HYDRANT LOCATION

- A. The Developer shall provide fire hydrants which conform to the requirements of these Specifications. Fire hydrant location and spacing shall be determined by the Fire Chief or the Town. As minimum general requirements, the number of fire hydrants, their location and spacing shall be as follows:
 - 1. Residential Areas - 500 feet between hydrants starting at street intersections.
 - 2. Multiple Dwellings - 500 feet between hydrants and not more than 400 feet to rear of premise.
 - 3. Commercial, Industrial, Storage - 500 feet between hydrants and not more than 350 feet to any other part of building.
 - 4. No fire hydrant line shall be connected to less than a six (6) inch water main or to a "dead end" eight (8) inch water main.

1.12 FIRE LINES & FIRE HYDRANT LINES

- A. A fire hydrant line shall extend from the hydrant tee on the water main to the fire hydrant.

- B. If allowed, private fire service main for use on an internal fire suppression system shall extend from the valve on the main to the base of the riser flange in the building.
- C. Plans for the installation of the above mentioned fire suppression lines must be submitted to the Town for approval and must be stamped by a Professional Engineer.
- D. The owner of any non-public fire service main or fire hydrant line is responsible for maintenance of that line from the valve on the Town main to and including the hydrant. Valves on newly constructed fire lines will be located on the tee at the main, be restrained at the tee and they shall open left (counter clockwise).
- E. Fire service lines and fire hydrant lines shall be separate from each other and all other service connections.
- F. The use of any private fire service main to supply more than one lot is not allowed.
- G. Private fire hydrants shall meet the requirements of Town of Wellington fire hydrants.

1.13 BACKFLOW PREVENTION

A. General

1. Water service lines, inside or outside of any property or building, shall have NO physical connection with any pipes, pumps, hydrants, or tanks that could draw or discharge any unsafe or contaminated water (including steam condensation or cooling water) into the water system.
2. At a minimum all water taps one-and-a-half inch (1-1/2") and larger shall be fitted with a Town approved backflow prevention assembly. All taps must be fitted with a backflow prevention assembly in ANY case where a cross connection potential exists. In addition, all commercial taps where a routine annual inspection of the plumbing system is not performed shall be fitted with an appropriate back flow prevention assembly. All assemblies shall be installed according to the Colorado Cross Connection Manual, latest edition, tested upon installation, and re-tested every year thereafter.
3. Reference the Uniform Plumbing Code, 2012 Edition for additional information regarding general requirements, heat exchangers, protection from lawn sprinklers and irrigation systems, and protection from fire systems.

B. Acceptable Backflow Prevention Assemblies

1. No person shall install any water operated equipment or mechanism, or use any water treating chemical or substance, if it is found that such equipment, mechanism, chemical or substance may cause pollution or contamination of the domestic water supply. Such equipment or mechanism may be permitted only when equipped with an approved backflow prevention device or assembly. See Table 2-1 for approved devices and assemblies

Table 2-1					
Backflow Prevention Devices, Assemblies and Methods					
Device Assembly or Method	Degree of Hazard				Installation Notes (1,2)
	Pollution (Low Hazard)		Contamination (High Hazard)		
	Back Siphonage	Back Pressure	Back Siphonage	Back Pressure	
Airgap	X		X		5
Atmospheric Vacuum Breaker	X		X		3,4,6
Spill-Proof Pressure Type Vacuum Breaker	X		X		4,7
Double Check Valve Backflow Preventer	X	X			8
Pressure Vacuum Breaker	X		X		9
Reduced Pressure Principle Backflow Preventer	X	X	X	X	10

Notes

1	Installation in pit or vault requires previous approval of Town
2	Refer to general and specific requirement for installation
3	Not to be subject to operating pressure for more than 12 hours in any 24 hour period
4	For deck mounted and equipment-mounted vacuum breakers, see appropriate section of 2012 UPC
5	See UPC 2012 Edition
6	Upright position. No Valves downstream. Minimum of six(6) inches or listed distance above all downstream plumbing and flood level rim of receptor
7	Upright position. Minimum of six(6) inches or listed distance above all downstream plumbing and flood level rim of receptor
8	Horizontal unless otherwise listed. Requires one (1) foot minimum clearance at bottom for maintenance. May need a platform/ladder for test and report. Does not discharge water
9	Upright position. May have valves downstream. Minimum twelve (12) inches above all downstream piping and flood level rim receptor. May discharge water.
10	Horizontal unless otherwise listed. Requires one (1) foot minimum clearance at bottom for maintenance. May need a platform/ladder for test and report. Does not discharge water

* * * END OF SECTION * * *

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SECTION 01656

DISINFECTION OF DOMESTIC WATER LINES

PART 1 GENERAL

1.1 DESCRIPTION

A. This section covers disinfection of potable water lines. Contractor is responsible for disinfection and testing of water lines.

1.2 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Exercise extreme care in handling of hypochlorites as they may be dangerous to health.

B. Standard: Forewords to both AWWA B-300 and AWWA C651.

PART 2 PRODUCTS

2.1 MATERIALS

A. Hypochlorites: Reference AWWA B300.

PART 3 EXECUTION

3.1 GENERAL

A. The Contractor shall flush and satisfactorily disinfect new water lines prior to placing them in service, in accordance with AWWA C651.

B. Heavy particulates generally will contain bacteria, and will prevent even very high concentrations of chlorine from contacting and killing such organisms. It is therefore essential that procedures be observed to assure that a water main and its appurtenances are thoroughly clean for the final disinfection by chlorination.

C. If dirt enters the pipe that, in the opinion of the Town, will not be removed by the flushing operation, the interior of the pipe shall be cleaned by mechanical means and then shall be swabbed with a 1 percent hypochlorite disinfection solution. Cleaning with the use of a pig, swab, or "go-devil" should be undertaken only when such operation will not force mud or debris into pipe joint spaces.

D. The Town shall operate existing valves to prevent the disinfectant solution from flowing back into the line supplying the water or into adjacent parts of the in-service distribution system.

- E. If it is not possible to keep the pipe and fittings dry during installation, every effort shall be made to assure that any of the water that may enter the pipe joint spaces contains an available chlorine concentration of approximately 25 mg/l. This may be accomplished by adding calcium hypochlorite granules to each length of pipe before it is lowered into a wet trench.
- F. If the main is flooded during construction, it shall be cleared of the flood water by draining and by flushing with potable water until clean. The section exposed to the flood water shall then be filled with chlorinated potable water which at the end of a 24-hour holding period will have a free chlorine residual of not less than 25 mg/l. The chlorinated water may then be drained or flushed from the main. After construction is completed, the main shall be disinfected using the continuous feed or slug method.
- G. Operate valves and other appurtenances while the lines are filled with heavily chlorinated water.
- H. Do not fill the pipe at a velocity greater than 6 fps.

3.2 PRELIMINARY FLUSHING

- A. Flush pipelines at a minimum velocity of 2.5 ft. /sec., in order to remove foreign material prior to disinfection.
- B. Do not use preliminary flushing with the tablet method of disinfection.

3.3 METHODS

- A. Disinfection by chlorination of the pipe shall be performed prior to acceptance by the Town. The chlorinating agent and method of application shall be approved by the Town in accordance with A.W.W.A. C-651. The Town has the authority to restrict the method of disinfection on a case by case basis.
- B. The chlorinated water shall be retained in the main for at least 24 hours, during which time all valves and hydrants in the section treated shall be operated in order to disinfect the appurtenances. At the end of this 24-hour period, the treated water in all portions of the main shall have a residual of not less than 10 mg/l free chlorine.
- C. Chlorine tablets are not to be used for disinfection, only granular methods.

3.4 FINAL FLUSHING

- A. Clearing the Main of Heavily Chlorinated Water
 - 1. After the applicable retention period, the heavily chlorinated water shall be flushed from the main until chlorine measurement show that the

concentration in the water leaving the main is no higher than that generally prevailing in the system.

B. Disposing of Heavily Chlorinated Water

1. The environment to which the chlorinated water is to be discharged shall be inspected and if there is any question that the chlorinated discharge will cause damage to the environment, then a reducing agent shall be applied to the water to be wasted to neutralize thoroughly the chlorine residual remaining in the water. Where necessary, federal, state, and local regulatory agencies should be contacted to determine special provisions for the disposal of heavily chlorinated water.
2. Chlorine residual of water being disposed will be neutralized by treating with one of the following chemicals:

Pounds of Chemicals Required to Neutralize Various Residual Chlorine Concentrations in 100,000 Gallons of Water				
Residual Chlorine Concentration mg/l	Sulfur Dioxide SO ₂	Sodium Bisulfite NaHSO ₃	Sodium Sulfite Na ₂ SO ₃	Sodium Thiosulfate Na ₂ SO ₃ 5H ₂ O
1.0	0.8	1.2	1.4	1.2
2.0	1.7	2.5	2.9	2.4
10.0	8.3	12.5	14.6	12.0
50.0	41.7	62.6	73.0	60.0

3.5 REPETITION OF PROCEDURE

- A. If the initial disinfection, or subsequent disinfections, fails to produce satisfactory samples, the main shall be reflashed and resampled. If the samples are still not satisfactory, the main shall be rechlorinated by the continuous-feed or the slug method of chlorination until satisfactory results are obtained.
- B. If the residual is less than 10 milligrams per liter the water lines shall be rechlorinated by the continuous-feed or slug method of chlorination and retested.

*** END OF SECTION ***

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SECTION 01666
TESTING & INSPECTION OF PIPING SYSTEM

PART 1 GENERAL

1.1 DESCRIPTION

A. This section covers hydrostatic testing of water lines.

PART 2 PRODUCTS

A. Section not used.

PART 3 EXECUTION

3.1 GENERAL

A. Once the pipeline has been backfilled, filled and disinfected, a pressure test shall be conducted.

1. The Contractor shall provide all equipment and personnel to perform the hydrostatic test.

a Test equipment shall be able to maintain a continuous internal pipe pressure of 150 psi and accurately measure leakage from the pipe over a 2 hour, minimum test period.

b The maximum allowable pressure gauge increment shall be 5 psi.

c A water meter shall be used to measure the amount of water used in pressurizing the system.

2. The Town shall witness tests.

B. Testing shall not occur until at least 7 days have elapsed since the last concrete thrust restraint was cast.

1. A minimum of 72 hours shall elapse if high-early - strength cement is used.

C. Unless prior permission is given by the Town, the hydrostatic pressure test shall be performed against all valves within the new piping system.

D. Pipe shall remain filled with water for a minimum of 24 hours prior to the hydrostatic pressure test.

E. Prior to the tests inspect valves within the test section to make sure they are fully open.

1. Hydrants: Test with the hydrant foot valve closed and the hydrant tee/auxiliary valve open.

3.2 PRESSURE TEST

A. "Leakage" is the quantity of water that must be added to the pipeline to maintain a pressure of within 5 psi of the specified test pressure after the air has been expelled and the pipe has been filled with water.

B. Test pressure.

1. Test pressure shall be 150 psi at the lowest elevation of the test section.
2. A residual pressure of within 5 psi of the test pressure shall be maintained for a minimum of 2 hours.

C. The maximum allowable leakage for each test section is determined by the following formula:

$$L = \frac{SxDx\sqrt{P}}{133,200}$$

Where: L = maximum allowable leakage, in gallons per hour.

Sx = length of pipeline tested, in feet.

Dx = nominal pipe diameter, in inches.

P = average test pressure during the leakage test, in psi (gauge).

Dx size inches	Sx Length ft	Test Pressure (P) psi	Leakage (2 hours) (gallons)
4	100	150	0.074
6	100	150	0.110
8	100	150	0.147
10	100	150	0.184
12	100	150	0.221
16	100	150	0.294
18	100	150	0.331
20	100	150	0.368
24	100	150	0.441

1. Reference AWWA C600.

D. Testing and Leakage.

1. When filling the pipeline, it shall be filled at a rate which will not cause surges nor will it exceed the rate at which the air can be released.
2. All air in the line shall be properly purged. Where blowoffs or hydrants are not available or effective in purging air from the line, the Town shall require a tap to purge the line. The location and the size of the tap shall be at the Town's discretion. Upon satisfactory completion of the test the tap shall be abandoned in place and the main encased in concrete.
3. Unless prior written permission is given by the Town, a test section shall not be any longer than length of pipe between adjacent line valves.
4. There will be no additional leakage allowance for valves.
5. Testing through fire hydrants between foot valves and caps shall not be allowed.

- E. Do not test against Town's existing valves. Provide temporary watertight plugs and temporary thrust restraint until tests pass. After system passes acceptable testing remove plugs and thrust restraint and connect to existing valve with cut-in sleeve or solid sleeve.

3.3 PASSING

- A. If the tests disclose leakage greater than that specified, the defective materials and joints shall be located and repaired.

1. The tests shall be repeated until the leakage is less than the maximum allowed.
- B. With the exception of obvious leaks, passing of the pressure test shall be on the basis of maximum allowable leakage per section tested.
1. No leakage is allowed through the bonnet of any valve or appurtenance. Any valve or appurtenance that leaks will be removed and replaced.
- C. If the pipeline under test contains sections of various diameters, the allowable leakage will be the sum of the computed leakage for each size.
- D. All visible leaks shall be repaired regardless of maximum allowable leakage.

* * * END OF SECTION * * *

SECTION 02221

TRENCHING, BACKFILLING AND COMPACTING

PART 1 GENERAL

1.1 DESCRIPTION

- A. This section covers excavation and trenching, including drainage, preparation of subgrades, pipe bedding, backfilling, compacting, and finish grading for underground pipelines and appurtenances.

1.2 QUALITY ASSURANCE

- A. "CDOT" refers to Colorado Department of Transportation designations in their "Standard Specifications for Road and Bridge Construction."
 - 1. When CDOT is referenced herein, Sections 100 through 109 and measurement and payment provisions will not apply.

1.3 JOB CONDITIONS

A. Right-of-Way

- 1. In developed areas haul and stockpile excess material or erect suitable bulkheads to prevent deposition of excavated material where right-of-way or easements are not adequate to stockpile all excavated material without depositing it on private property.

B. Blasting

- 1. Blasting is not permitted within the jurisdiction of the Town.

C. Drainage and Groundwater

- 1. Maintain excavations and trenches free from water during construction.
- 2. Remove water encountered in the trench to the extent necessary to provide a firm subgrade, to permit joints to be made in the dry, and to prevent the entrance of water into the pipeline.
- 3. Divert surface runoff and use sumps, gravel blankets, well points, drain lines or other means necessary to accomplish the above.

4. Maintain the excavation of trench free from water until the structure, or pipe to be installed therein, is completed to the extent that no damage from hydrostatic pressure, flotation, or other cause will result.
5. Uncontaminated groundwater shall be prevented from entering into previously constructed pipe.
6. Groundwater contaminated by sanitary waste shall be discharged into the sanitary sewer.
7. The pipe under construction shall not be used for dewatering.

D. Sequencing

1. Perform pipeline installation within 50 linear feet of trench excavation.
2. Perform trench backfill within 50 linear feet of pipe installation.
3. Perform clean-up within 200 linear feet of trench excavation.
4. Where excavation is a hazard to automotive or pedestrian traffic, the amount of open trench and the time duration of that opening is to be minimized.
5. Maintain access to private residence and businesses.

E. Underground Obstructions

1. Contractor is responsible for the location and verification of all underground utilities and obstructions.
2. Maintain, protect and support by shoring, bracing or other means existing utilities, appurtenances and structures.
3. Take such protective measures as the utilities may direct where protection, alternations or moving of the utilities is required.

F. Weather

1. Do not backfill or construct fills or embankments during freezing weather.
2. Do not place backfill, fill or embankment on frozen surfaces.
3. Do not place frozen materials, snow or ice in backfill, fill or embankments.
4. Do not deposit, tamp, roll or otherwise mechanically compact backfill in water.

1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Storage

1. Provide adequate and orderly storage of excavated material adjacent to Work.
2. Pile suitable material for backfilling in an orderly manner a sufficient distance from banks or trench or excavation to avoid overloading and to prevent slides or cave-ins.
3. Do not stockpile excavated materials against existing structures, Work, or appurtenances.
4. Excess excavated material will not remain on job site for more than one (1) month without approval from the Town.

1.5 MAINTENANCE AND CORRECTION

- A. Scarify surface, reshape, and compact to required density completed or partially completed areas of work disturbed by subsequent construction operations or by adverse weather.
- B. Maintain and correct backfill, fill and embankment settlement and make necessary repairs to pavement structures, seeding and sodding which may be damaged as a result of settlement for period of two (2) years after Substantial Completion and acceptance of The Work.

PART 2 MATERIALS

2.1 GENERAL

- A. All material shall be free from frozen matter, stumps, roots, brush, other organic matter, cinders or other corrosive material, debris, broken asphalt and concrete, and any other material that is not suitable in the opinion of the Town.
- B. If job excavated material is not sufficient or suitable, suitable material shall be imported. All imported material shall have a liquid limit not greater than 30 and a plasticity index not greater than 6.

2.2 STABILIZATION MATERIAL

- A. Top 6 inches of pipe subgrade - If the existing soil in the trench bottom is judged to be unsuitable the top 6-inches of the pipe subgrade shall be removed and replaced with a stabilization material.

1. Stabilization material is crusher-run rock, conforming to ASTM D448, size #357.

<u>SIZE</u>	<u>PERCENT PASSING</u>
2 ½"	100
2"	95-100
1"	35-70
½"	10-30
#4	0-5

- B. Geotextile: CDOT, Section 712.08, Class A Table 712-2.
- C. Subgrade below top 6 inches - Same as top 6 inches except that broken concrete and rock may be included in sizes permitting compaction as specified without discernible voids.
- D. Alternative materials for stabilization of sub-grade will be considered for use as approved by the Town and Engineer.

2.3 BEDDING MATERIALS

- A. Definition: Materials placed from the subgrade to an elevation 12 inches above the top of pipe.
- B. Granular material
 1. Angular crushed rock, conforming to CDOT #67

<u>SIZE</u>	<u>PERCENT PASSING</u>
1"	100
¾"	90-100
⅜"	20-55
#4	0-10
#8	0-5

2. Or, well-graded angular crushed rock: 95% passing a one (1) inch sieve and not more than 5% passing a No. 4 sieve.
- C. Concrete
 1. Compressive strength: 4000 psi at 28 days minimum.
 2. Class A concrete, reference Colorado Department of Transportation, Division of Highways, State of Colorado "Standard Specifications for

Road and Bridge Construction" section 601. Sections 100 through 109 and measurement and payment provisions shall not apply.

D. Barrier material.

1. Soil Classification.

- a GC - clayey gravels, gravel-sand-clay mixtures.
- b SC - clayey sands, sand-clay mixtures.
- c CL - inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, clean clays.
- d Material shall not be lumpy or hard but shall be finely divided, suitable, and free from stones.

E. Bedding material for service lines less than four (4) inches in diameter shall be sands or silts and clays meeting the Unified Soil Classification types ML or CL. Material shall not be lumpy or hard but shall be finely divided, suitable, and free from stones greater than ½ inch in its largest dimension.

2.4 TRENCH BACKFILL MATERIAL

- A. Trench backfill material shall be placed from a point 12-inches above the pipe to 6-inches below the ground surface, to bottom of topsoil layer, or to the bottom of the pavement subgrade, whichever is applicable.
- B. Trench backfill material shall be soil free from any rocks or stones which are larger than 6-inches, in any dimension.
 - 1. Rocks or stones which are larger than 3-inches, in any dimension, shall not be placed within one foot of pavement subgrade, or within one foot of the finished surface of unpaved areas.
 - 2. Material shall not be lumpy or hard but shall be finely divided.

PART 3 EXECUTION

3.1 PREPARATION

A. Topsoiling Remove a minimum of 6 inches of topsoil and stockpile topsoil away from areas to be disturbed by construction. Keep topsoil segregated from non-organic excavation materials and debris.

3.2 TRENCHING

- A. Excavate trenches by open cut methods, except where boring or tunneling is indicated in the Contract Documents, required by jurisdictional agencies or desired by Contractor to avoid removal of obstructions.
- B. Do not use mechanical equipment in locations where its operation would cause damage to trees, buildings, culverts, or other property, utilities, or structures above or below ground. In all such locations, hand excavating methods shall be used.
- C. Use mechanical equipment so designed and operated that the rough trench excavation bottom elevation can be controlled with uniform trench widths and vertical sidewalls from an elevation one foot above the top of the installed pipe to the bottom of the trench, and trench alignment sufficiently accurate to permit pipe to be aligned properly between the pipe and sidewalls of the trench. Do not undercut the trench sidewall to obtain clearance.
- D. Excavation in rock
 - 1. Over excavate a minimum of six inches below the bottom of the pipe.
 - 2. Backfill with Granular Material
- E. Preparation of Trench Bottom
 - 1. Grade trench bottoms uniformly to provide clearance for each section of pipe.
 - 2. Remove loose materials, water and foreign objects.
 - 3. Provide firm subgrade suitable for application of bedding material.
 - 4. Wherever unstable material is encountered in the bottom of the trench, over-excavate such material to a depth suitable for construction of a stable subgrade. Backfill overdepth with Stabilization Material and compact. A layer of geotextile fabric shall be placed between the stabilization material and the bedding material.
 - 5. Alternative techniques for stabilization of sub-grade shall be in accordance with manufacturer's instructions or geotechnical engineer's recommendations.
- F. Stockpiling Excavated Materials.
 - 1. Pile suitable material for backfilling in an orderly manner a sufficient distance from banks of the trench to avoid overloading and to prevent slides or cave-ins.

2. Remove and dispose of excess excavated materials not suitable or not required for backfilling.
3. Do not stockpile excavated material against existing structures or appurtenances.
4. Excess excavated material will not remain on job site for more than one (1) month.

G. Limiting Trench Widths

1. Trenches shall be excavated to a width necessary to provide a 12-inch minimum working space between the pipe and the trench walls for proper pipe installation, joining, and bedding.
2. The minimum trench width at an elevation 12 inches above the top of the installed pipe shall be 2 barrel diameters of the pipe or 32 inches whichever is greater.
 - a. If the width of the trench, 12 inches above the top of the installed pipe, exceeds the maximum allowable trench width, a higher strength pipe or special pipe bedding shall be provided, as required by soil loading conditions and as determined by the Town.

3.3 PIPE BEDDING

A. Bedding classes: Place pipe bedding in accordance with the details shown on the Drawings. Provide higher class bedding where unexpected trench conditions are encountered.

B. Placement and Compaction

1. Distribute and grade bedding material to provide uniform and continuous support beneath the pipe at all points between bells and pipe joints.
2. Deposit bedding material and compact uniformly and simultaneously on each side of the pipe to prevent lateral displacement.
3. Compact granular bedding material by vibrating, slicing with a shovel, or bent tee-bar.

C. Ground Water Barriers

1. To impede passage of water through bedding material, construct a ground water barrier the full trench width, approximately 4 feet long, and from the bottom of all Granular Material to top of Granular Material.

2. Space:

- a Approximately 10 feet downstream of each manhole for sanitary sewers and storm drains.
- b Every 400 feet on water lines and force main.
- c Place a ground water barrier 20 feet downstream of the edge of all drainage ways, streams and water courses.

D. Over Depth Excavation

- 1. Restore over excavated subgrades to proper elevation with Stabilization Material or Granular Material.

3.4 BACKFILLING AND COMPACTION

- A. Backfill trench promptly after completion of pipe bedding.
- B. Deposit backfill material in uniform layers not exceeding eight inches in uncompacted thickness. Increased layer thickness may be acceptable provided it is demonstrated that the specified compacted density will be obtained.
- C. Use methods and equipment appropriate for the backfill material. Do not use equipment or methods that will transmit damaging shocks to the pipe.
- D. Do not perform compaction by jetting or water settling.
- E. Import material for trench backfill if compaction cannot be obtained with job excavated material, when specifically required by these Contract Documents, or required by jurisdictional authorities.
- F. Rock and bedrock encountered in the excavation shall be separated from other excavated material and disposed of by Contractor.
- G. Topsoiling - Replace topsoil after construction and grading to the depth of stripping over all areas disturbed by construction operations and which will not receive other surface treatment.
- H. Obtaining a site for disposal of excavated rock and bedrock material, excess excavated materials, and material not suitable for backfilling is the responsibility of Contractor. If excavated materials are disposed on private property, written permission shall be obtained from the property owner and a copy given to Town.

3.5 FIELD QUALITY

A. Field Compaction Control

1. Field tests will be conducted to determine compliance of compaction methods with specified density in accordance with:
2. ASTM D2922 (AASHTO T238) - Tests for Density of Soil and Soil - Aggregate In-Place by Nuclear Methods, or
3. ASTM D1556 (AASHTO T191) - Tests for Density of Soil In-Place by the Sand Cone Method, or
4. ASTM D2167 (AASHTO T205) - Tests for Density of Soil In-Place by Rubber-Balloon Method.

B. Compaction shall be to the following minimum densities, reference ASTM D698 or AASHTO T99 unless otherwise indicated.

1. Subgrade under footings or foundations: 100%
2. Barrier material: 95%
3. Pipe bedding
 - a Compacted granular material: 80% (ASTM D4253, D4254)
 - b Barrier material: 95%
4. Trench backfill
 - a Within right of way and under areas of permanent surface improvements: 95%
 - b Under footings, foundations or structures: 95%.
 - c Seeded areas: 88%
 - d All other locations: 95%.
 - e Do not compact topsoil.
5. Where granular materials are used in lieu of cohesive soils reduce the above percentages by 15% to arrive at the relative density and ASTM D4253 and D4254 shall apply.

C. Moisture Content

1. All compacted backfill shall be within 2% (+/-) of the optimum moisture content of the soil as determined by ASTM D698.

2. Water shall be added to the material, or the material shall be harrowed, disced, bladed, or otherwise worked to insure uniform moisture content, as specified.

3.6 TRENCH COMPACTION – SANITARY AND STORM SEWER

- A. A compaction test shall be performed for every lift, maximum lift depth = 12”, every 200 feet along the trench or as directed by the Engineer.
- B. Two compaction tests shall be performed on every lift, maximum lift depth = 12”, at each manhole

3.7 TRENCH COMPACTION - WATER

- A. A compaction test shall be performed for every lift, maximum lift depth = 12”, every 200 feet along the trench or as directed by the Engineer.
- B. Two compaction tests shall be performed on every lift, maximum lift depth = 12”, in the vicinity of all valves

3.8 COMPACTION TEST FAILURE

- A. If the required state of compaction is not obtained, it shall be the responsibility of the Contractor to recompact the material to the required state of compaction. In cases where there is a failure to achieve the required state of compaction, the Town may require that the backfill be removed and recompacted or replaced.
- B. A hydrostatic retest shall be required on water lines after recompaction if the hydrostatic testing had been performed prior to recompaction.
 1. Testing shall be performed between valves on both sides of area of recompaction.
- C. A retest of wastewater lines shall be required after recompaction if the testing has been performed prior to recompaction.
 1. Testing shall be performed between manholes on both sides of area of recompaction.

* * * END OF SECTION * * *

SECTION 02321

CONTROLLED LOW STRENGTH MATERIAL BACKFILL (FLO-FILL)

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. The CONTRACTOR shall furnish and place controlled low strength material (CLSM) backfill where shown in the Drawings.

1.2 RELATED WORK

- A. Section 02225 - Trenching, Bedding and Backfill

1.3 REFERENCES

- A. ASTM C 33 - Concrete Aggregates
- B. ASTM C 94 - Specification for Ready-Mixed Concrete
- C. ASTM C 143 - Test Method for Slump of Hydraulic Cement Concrete
- D. ASTM C 150 - Portland Cement
- E. ASTM C 494 - Chemical Admixtures for Concrete
- F. ASTM C 618 - Fly Ash in Portland Cement Concrete
- G. ASTM D 4832 - Standard Test Method for Preparation and Testing of Soil- Cement Slurry Test Cylinders
- H. ASTM PS 28 - Provisional Standard Test Method for Flow Consistency of Controlled Low Strength Material
- I. ASTM PS 29 - Provisional Standard Test Method for Unit Weight, Yield and Air Content (Gravimetric) of Controlled Low Strength Material
- J. ASTM PS 30 - Provisional Standard Practice for Sampling Freshly Mixed Controlled Low Strength Material
- K. ASTM PS 31 - Provisional Standard Test Method for Ball Drop on Controlled Low Strength Material to Determine Suitability for Load Application

1.4 SUBMITTALS:

- A. A minimum of two days prior to starting CLSM work, CLSM mix design shall be submitted for review and approval. No changes shall be made in the amounts or sources of the approved mix ingredients without the approval of the ENGINEER. Product inspection and field testing of the approved mix may be made by, or on- behalf of, the OWNER.

PART 2 PRODUCTS

2.1 MATERIALS

- 2.2 General: The CLSM shall consist of a mixture of sand, coarse aggregate, cement and water. Fly ash and approved admixtures may be used to obtain the required properties of the mix. The mix shall have good workability and flowability with self-compacting and self-leveling characteristics. Proportions of the mix shall be as given in the following table:

CLSM Mix Proportions

COMPONENT	AMOUNT
Cement	42 lbs.
Fine Aggregate	1,845 lbs.
Coarse Aggregate	1,700 lbs.
Water	235 lbs.

- A. Cement: All cement used shall be Type II Portland cement, which shall conform to the requirements of ASTM C 150.
- B. Fly Ash: Fly ash may be either Class C or Class F. The fly ash shall conform to ASTM C 618.
- C. Aggregates:
1. Fine Aggregate: All fine aggregate shall conform to the grading and quality requirements of ASTM C 33.
 2. Coarse Aggregate: Coarse aggregate shall conform to the grading and quality requirements of ASTM C 33 for size No. 57 or No. 67.
- D. Water: The batch mixing water and mixer washout water shall conform to the requirements of ASTM C 94. The Water: Cement ratio shall be 5.6:1.
- E. Admixtures: Chemical admixtures that do not contain calcium chloride and conform to ASTM C 494 for concrete may be used in the CLSM mix.

All chemical admixtures shall be compatible with the cement and all other admixtures in the batch.

F. CLSM Properties:

1. Strength: CLSM shall have a maximum 28 day compressive strength of 60 psi when molded and cured as in conformance with ASTM D 4832.
2. Air-Entrainment: All CLSM shall be air entrained to a total air content of 4– 8 %.
3. Slump: The minimum slump shall be seven inches and the maximum slump shall be nine inches as when tested in accordance with ASTM PS 28.
4. Aggregate: Fine aggregate shall be between 50% and 60% by volume of the total aggregates in the CLSM mix.
5. Consistency: The consistency of the CLSM slurry shall be such that the material flows easily into all openings and the area to be filled. When trenches are on a steep slope, a stiffer mix of slurry may be required to prevent CSLM from flowing down the trench. When a stiffer mix is used, vibration shall be performed to ensure that the CLSM slurry completely fills all spaces between the pipe and the lower portion of the trench.

PART 3 EXECUTION

3.1 PLACEMENT

- A. CLSM shall be used as an alternative to backfill, as directed by the ENGINEER, but may not be used as a substitute for bedding material.
- B. Rodding, mechanical vibration and compaction of CLSM shall be performed to assist in consolidating the CLSM.
- C. CLSM shall be placed as closely behind pipe laying operations as possible.
- D. When required to prevent uplift, the CLSM shall be placed in two stages as required, allowing sufficient time for the initial set of the first stage before the remainder is placed. CLSM shall be deposited as nearly as practical in its final position and in no way disturb the pipe trench or cause foreign material to become mixed with the CLSM.
- E. Soil backfill shall not be placed until the CLSM has reached the initial set. If backfill is not to be placed over the CLSM within 8 hours, a 6-inch cover of moist earth shall be placed over the CLSM surface.

- F. If the air temperature is 50° F or less, the moist earth cover should be at least 18-inches thick. CLSM shall not be placed when the air temperature is below 40° F unless the air temperature is 35° F or more and the temperature is rising.
- G. CLSM shall not be placed, if, in the judgment of the ENGINEER, weather conditions are unsuitable.
- H. CLSM shall not be placed when the trench bottom or walls are frozen or contain frozen material

END OF SECTION

SECTION 02615

DUCTILE IRON PIPE

PART 1 GENERAL

1.1 DESCRIPTION

- A. This section covers furnishing and installation of, 4-inch through 16-inch, ductile iron pipe and larger and fittings.

1.2 PRODUCT DELIVERY

A. Handling.

1. Use slings, pipe tongs or skids.
2. Do not drop pipe or fittings including dropping on cushions.
3. Do not skid or roll pipe into pipe already on the ground.
4. Do not damage coating or lining.
5. Do not use hooks.
6. Pipe shall not be handled in any manner which will cause damage.

B. Storage.

1. Store and use lubricants in a manner which will avoid contamination.
2. Store rubber gaskets in a cool, dark location away from grease, oil, and ozone producing electric motors.
3. Do not exceed maximum stacking heights listed in AWWA C600, Tables 1 and 2.

PART 2 PRODUCTS

2.1 PIPE

A. Buried Ductile Iron Pipe, 12" and smaller.

1. Standard: AWWA C151
2. Pressure Class: 350
3. Lay Length: 18 or 20 feet.

- a Random pipe lengths are not acceptable.

B. Flanged Ductile Iron Pipe, 12” and smaller.

- 1. Standard: AWWA C115
- 2. Thickness Class: 50
- 3. Lay Length: 18 or 20 feet.

C. Ductile Iron Pipe, 16” and greater.

- 1. Standard: AWWA C151
- 2. Pressure Class: 250
- 3. Lay Length: 18 or 20 feet.
 - a Random pipe lengths are not acceptable.

D. Manufacturers

Push-on Joint Pipe Manufacturers:

- a U.S. Pipe, Tyton Joint
- b Pacific States Pipe, Tyton Joint
- c Or approved equal

2. Restrained Joint Pipe Manufactures:

- a U.S. Pipe, TR FLEX
- b Pacific States Pipe, SUPER-LOCK
- c Or approved equal.

3. Restraint of field cut pipe (pipe without weldment) shall be provided with U.S. Pipe's TR FLEX GRIPPER Ring or approved equal.

2.2 PIPE JOINTS

A. Mechanical and Push-On.

- 1. Standard: AWWA C111.
- 2. Gaskets: Synthetic Rubber.

3. Lubricant: Furnished by pipe manufacturer.
4. Bolts and nuts: high strength, low alloy steel, ASTM A325, Type 3. ("Cor-ten", "Usalloy")

B. Flanged

1. Standard: AWWA C115.
2. Flanges: ANSI B16.1.
3. Drilling: 125 lb., unless otherwise indicated.
4. Gaskets: AWWA C110, Appendix A, full face red rubber, 1/8 inch thick.
5. Bolts and nuts:
 - a Use corrosion resistant, high strength, low alloy steel, bolts and nuts where buried, immersed, in saturated air and in splash zones: ASTM A 325, Type 3. (Cor-Ten, Usalloy, or equal)
6. Restrained mechanical joints shall include a restraining mechanism with a pressure rating equal to that of the pipe on which it is used and shall have a safety factor of at least 2:1. The restraining gland shall be listed by Underwriters Laboratories Inc., be approved by Factory Mutual Research, and conform to the requirements of ASTM 1674, and UNI-B-13-94.
7. Restrained Joint:
 - a EBAA, 2000PV
 - b Star Pipe Products, PVC Stargrip 4000
 - c Or approved equal

2.3 FITTINGS

A. Flanged:

1. Standard: AWWA C110
2. Material: ductile iron
3. Fitting Class: 250
4. Flange Class: 125, threaded

5. Gaskets for Flanges: AWWA C110, Appendix A, full face red rubber, minimum 1/8 inch thick. Bolts and nuts: high strength, low alloy steel, ASTM A325, Type 3. ("Cor-ten", "Usalloy")

B. Mechanical Joint:

1. Standard: AWWA C111
2. Material: ductile iron.
3. Fitting Class: 250
4. Bolts and nuts: high strength, low alloy steel, "Cor-ten", "Usalloy", or equal.
5. Fittings shall be lined and coated as specified below.

2.4 PIPE & FITTING LINING

A. Waterline:

1. Cement Mortar
2. Standard: AWWA C104

B. Pump Discharge Piping, Force Main:

1. Ceramic Epoxy: PROTECTO 401 manufactured by U.S. Pipe
2. Thickness: 40 mils

2.5 PIPE COATINGS

A. Bituminous: 1 mil. minimum.

2.6 POLYETHYLENE TUBING

- A. Standard: AWWA C105.
- B. Method A.
- C. Thickness: 8 mil min.
- D. Tape: Protecto Wrap Tape shall be #200 or #200A.

PART 3 EXECUTION

3.1 INSPECTION

A. The pipe and pipe coatings shall be inspected for damage or defects before being placed in the trench. Examine pipe and fittings and do not use individual section's containing:

1. Cracks
2. Flaws
3. Broken or loose lining
4. Abrasions
5. Other defects

B. Mark defective pipe and remove from the site.

3.2 INSTALLATION

A. DEWATERING

1. All pipe trenches and excavation for structures and appurtenances shall be kept free of water during pipe laying and other related work. The method of dewatering shall provide for a dry foundation at the final grades of excavation in accordance with Section 02221, Trenching, Backfilling and Compacting. Water shall be disposed of in a manner that does not inconvenience the public or result in a menace to public health. Pipe trenches shall contain enough backfill to prevent pipe flotation before dewatering is discontinued. Dewatering shall continue until such time as it is safe to allow the water to rise in the excavation.

B. LAYING, ALIGNING, AND JOINING PIPE

1. Pipe shall be installed in accordance with the manufacturer's recommendations for installing the type of pipe used, unless otherwise shown on the Drawings. Proper equipment, implements, tools and facilities shall be provided and used by the Contractor for safe and convenient installation of the type of pipe being installed.
2. Pipelines shall be laid to the grades and alignment shown on the Drawings. Obstructions not shown on the Drawings may be encountered during the progress of the work. Should such an obstruction require an alteration to the pipe alignment or grade, the Contractor shall notify the Owner's Representative who has the authority to order a deviation from the Drawings, or he may arrange for the removal, relocation, or reconstruction of any structures which obstruct the pipeline.
3. Precautions shall be taken to prevent foreign material from entering the pipe before or while it is being placed in the line. During laying

operations, no debris, tools, clothing or other materials shall be placed in the pipe. The open ends of pipe shall be closed with a watertight plug, or with other devices approved by the Engineer, at times when pipe laying is not in progress.

4. Cutting the pipe.
 - a Cut pipe smooth, straight and at right angles to the pipe axis.
 - b Do not damage the pipe or cement lining.
 - c Use a new abrasive wheel for ductile iron pipe.
 - d Grind cut ends and rough edges smooth.
 - e Bevel the cut end for push-on joints.
5. Field Joints.
 - a Use push-on joints for pipe and fittings except where thrust restraints are needed and where indicated otherwise on the Drawings.
 - b All joints shall be watertight and free from leaks.
 - c Do not deflect joint beyond 80% of the manufacturer's maximum values.

3.3 POLYETHYLENE TUBING.

1. Use loose polyethylene encasement in all locations, including:
 - a Valves
 - b Fittings
 - c Couplings
 - d Tie Rods
2. Install polyethylene tubing per AWWA C105, Method A.
 - a Cut polyethylene tube to a length approximately 2-feet longer than that of the pipe section.
 - b Slip the tube around the pipe, centering it to provide one (1) foot overlap on each adjacent pipe section, and bunching it accordion fashion lengthwise until it clears the pipe ends.

- c A shallow bell hole must be made at joints to facilitate installation of the polyethylene tube.
- d After assembling the pipe joint, make the overlap of the polyethylene tube.
- e Pull the bunched polyethylene from the preceding length of pipe, slip over the end of the new length of pipe, and secure in place with adhesive tape.
- f Then slip the end of the polyethylene from the new pipe section over the end of the first wrap until it overlaps the joint at the end of the preceding length of pipe and secure in place with adhesive tape.
- g Take up slack width to make a snug, but not tight, fit along the barrel of the pipe, securing the fold at quarter points.
- h Repair any rips, punctures or other damage to the polyethylene with adhesive tape or with a short length of polyethylene tube cut open, wrapped around the pipe and secured in place with adhesive tape.

3.4 BEDDING AND BACKFILLING

- A. Select bedding and backfill material may be required and shall be so shown on the Drawings. Select bedding materials shall conform to the designated gradation requirements in Section 02221, Trenching, Backfilling and Compacting.
- B. Bedding material shall be placed under and around all pipe as shown on the Drawings. Bedding shall be placed in a manner that will minimize separation or change in its uniform gradation. Bedding shall be distributed in 6-inch maximum layers over the full width of the trench and simultaneously on both sides of the pipe. Special care shall be taken to assure full compaction under the haunches and joints of the pipe.
- C. Backfill compaction shall not be attained by inundation or jetting. Backfill material shall be uniformly compacted the full depth of the trench.

3.5 JOINT INSTALLATION

- A. Push-On Joints.
 - 1. Clean the inside of the bell and the outside of the spigot to remove dirt, oil, excess coating and other foreign matter.
 - 2. Insert the gasket.

3. Apply a thin film of lubricant to either the inside surface of the gasket, the spigot end of the pipe or both.
4. Do not permit the joint surfaces to come in contact with the ground.
5. Assure that pipe is marked with a depth mark before assembly to assure the spigot end is inserted the full depth of the joint.
6. Complete the joint making certain the spigot is inserted to the depth mark.
 - a Do not stab pipe.

B. Mechanical Joints.

1. Remove all dirt, oil, grit, excess coating and other foreign matter from the inside of the bell and the outside of the spigot.
2. Apply a thin film of lubricant to the inside of the bell, the outside of the spigot and the gasket.
3. Tighten nuts alternately on opposite sides of the pipe to produce equal pressure on all parts of the gland.
4. Use a torque limiting wrench and apply appropriate torque per manufacturer's recommendations.
5. Holes in mechanical joint bells shall straddle the top (or side for vertical piping) centerline.

C. Restrained Joints.

1. Remove all dirt, oil, grit, excess coating and other foreign matter from the inside of the bell and the outside of the spigot.
2. After the gasket has been inserted into the gasket seating area of the socket, apply a thin film of lubricant to the inside of the bell, the outside of the spigot and the gasket.
3. Insert the locking segments into the bell per the manufacturer's instructions.
4. Set joint deflection as required. Do not deflect joint beyond 80% of the manufacturer's maximum values.

D. Flanged Joints.

1. Extend pipe completely through screwed-on flanges.
2. Machine finish the pipe end and flange face in a single operation.

3. Eliminate any restraints on the pipe, which would prevent uniform gasket compression or cause unnecessary stress in the flanges.
4. Do not assemble mechanical connections until all flanged joints affected thereby have been tightened.
5. Alternately tighten bolts spaced on opposite sides of the pipe to assure uniform gasket compression.
6. Holes in flanges shall straddle the top (or side for vertical piping) centerline.

3.6 TESTING

- A. Buried piping shall be hydrostatically tested. Refer to Section 01666, Testing and Inspection of Piping System.
- B. Potable water piping shall be disinfected and flushed prior to operation. Refer to Section 01656, Disinfection of Domestic Waterlines.

3.7 CLEAN UP

- A. All rubbish, unused materials and other non-native materials shall be removed from the job site. All excess excavation shall be disposed of as specified, and the disturbed area shall be left in a state or order of cleanliness.
- B. The Contractor shall also abate dust nuisance by cleaning, sweeping, and sprinkling with water, or other means as necessary. The use of water resulting in mud on public streets will not be permitted as a substitute for sweeping or other methods.
- C. Materials and equipment shall be removed from the site as soon as they are no longer necessary; and upon completion of the work and before final inspection, the entire worksite shall be cleared of equipment, unused materials, and rubbish so as to present a satisfactory clean and neat appearance. All cleanup costs shall be included in the Contractor's bid.
- D. Failure of the Contractor to comply with the Inspector's cleanup orders may result in an order to suspend work until the condition is corrected. No additional compensation will be allowed as a result of such suspension.

END OF SECTION

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SECTION 02621
PLASTIC PRESSURE PIPE

PART 1 GENERAL

1.1 DESCRIPTION

- A. This section covers the furnishing and installation of plastic pressure pipe and fittings.

PART 2 PRODUCTS

2.1 MATERIALS

- A. PVC Pressure Pipe (4 inch through 12 inches).

1. Conformance: AWWA C-900.
2. O.D. Base: Cast Iron equivalent.
3. Pressure Class: 150 psi, 18 DR. (Minimum)
4. Joints: Bell ends with elastomeric gaskets. Solvent cement joints are strictly prohibited.

- B. Fittings: Ductile Iron.

1. Standard: AWWA C-104, C-110, C-111, or C-153.
2. Lining: Cement mortar, standard thickness.
3. Pressure rating: 250 psi.
4. Connections: mechanical joint unless specified otherwise indicated.
 - a Tee-head bolts and nuts: high strength, low alloy steel "Cor Ten", "Usalloy", or equal.

- C. Tracer wire.

1. Copper: #12 stranded, water-tight insulation for direct bury.
2. Termination Box: Equal to a cathodic protection test station termination box.

- D. Permatex

1. Permatex shall be installed at locations specified on drawings or as called for in Town specifications in accordance with manufacturer's recommendations.

E. Protecto Wrap

1. Protecto Wrap shall be installed at locations specified on drawings or as called for in Town specifications in accordance with manufacturer's recommendations.

F. Anode

1. Anodes shall be placed on all metal fittings in accordance with manufacturer's recommendations.

PART 3 EXECUTION

3.1 INSPECTION

- A. Examine the pipe and fittings for cracks, dents, abrasions or other flaws prior to installation. Mark defective pipe and remove from the site.3.2

3.2 INSTALLATION

- A. Install pipe in accordance with Section 02713, "Water Distribution and Transmission System."

B. Cutting the pipe.

1. Cut the pipe square with saws or pipe cutters designed specifically for the material.
2. Bevel the end in accordance with the manufacturer's recommendations.
3. Locate a depth mark with a marker or crayon to assure the spigot end is inserted to the recommended depth.
4. Remove burrs and wipe off all dust from the jointing surfaces.

C. Gasketed joints.

1. Remove all dirt and foreign material from the spigot, gasket and gasket groove.
2. Apply lubricant furnished by the pipe manufacturer.
3. Insert the spigot to the depth recommended by manufacturer.

4. Do not disturb previously completed joints during jointing operations.
- D. Do not bend pipe on any radius. Joints may be deflected if manufacturer's written literature allows, but bending of pipe is not allowed.
- E. Joints of all pipe in the trench shall be completed before work is stopped. If water accumulates in the trench, the plugs shall remain in place until the trench is dry.
- F. Tracer wire.
 1. Tape to top centerline pipe every 5 feet with tape such that wire remains in place during embedding of pipe.
 2. As an alternative to taping, spiral wrap tracer wire around pipeline in a symmetric pattern. Taping is not required with this method of installation.
 3. Secure tracer wire to fire hydrant by wrapping twice around riser to hydrant. Terminate end of tracer wire in a pre-fabricated cathodic protection test station. Two (2) feet of wire shall be coiled inside each box. See Drawing Exhibit 2-8 for detail.
 4. Wire may be spliced with plastic ties. Totally enclose in waterproof Permatex. Double wrap in Protecto-Wrap.
 5. Attach one pound sacrificial anodes to tracer wire every 500 feet.
 6. Testing.
 - a Pass current through wire and demonstrate that wire is capable of locating the pipe.
 - b If wire will not pass current, locate break in circuit and test until tracer wire works in accordance with its intended use.

3.3 TAPPING

- A. Tapping of PVC. up to and including two (2) inch shall be done only with approved tapping saddles.
- B. Taps larger than two (2) inches in size shall be made only with approved tapping saddles, sleeves, or fittings as determined by the Town and shall be stainless steel only.
- C. Taps shall be no closer than two (2) feet of each other.

* * * END OF SECTION * * *

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SECTION 02623
FUSIBLE POLYVINYL CHLORIDE PIPE

PART 1 GENERAL

1.1 DESCRIPTION

A. SCOPE

1. This section specifies fusible polyvinyl chloride (FPVC) pipe, including standards for dimensionality, testing, quality, acceptable fusion practice, safe handling, storage and installation of the pipe by pipe bursting and horizontal directional drilling (HDD) for potable and non-potable waterlines.

B. REQUIREMENTS:

1. Contractor shall provide fusible polyvinyl chloride pipe conforming to all standards and procedures, and meeting all testing and material properties as described in this specification for installation by pipe bursting.
2. Contractor shall be responsible for all installation processes and procedures associated with the installation by pipe bursting in accordance with this specification.

C. PIPE DESCRIPTION

1. Pipe Supplier shall furnish fusible polyvinyl chloride pipe conforming to all standards and procedures, and meeting all testing and material properties as described in this specification.
2. Pipe shall conform to the following dimensionality and general characteristics table:

<u>Pipe Description</u>	<u>Nominal Diameter (in.)</u>	<u>DR</u>	<u>Color</u>	<u>Pressure Class (psi)</u>
C-900-water	4-12	18	Blue	150
C-905-water	14-24	18	Blue	150
C-900-irrigation	4-12	18	Purple	150
C-905-irrigation	14-24	18	Purple	150
ASTM D3034 SDR35- Sanitary	4-15	NA	Green	NA
ASTM F-679 SDR35- Sanitary	18-27	NA	Green	NA
Surface water	4-27	NA	White	NA
Larger pipe to be reviewed by Town Engineer				

1.2 QUALITY ASSURANCE

A. REFERENCES:

1. This section contains references to the following documents, which are a part of this section as specified and modified. Where a referenced document contains references to other standards, those other standards are included as references under this section as if referenced directly. In the event of a conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.
2. Unless otherwise specified, references to documents shall mean the documents in effect at the time of design, bid, or construction, whichever is earliest. If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued.
3. Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, regardless of whether the document has been superseded by a version with a later date, discontinued or replaced.

Reference	Title
ANSI/AWWA C110/A21.10	American National Standard for Ductile-Iron and Gray-Iron Fittings, 3-inch through 48-inch, for Water and Other Liquids
ANSI/AWWA C111/A21.11	American National Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
ANSI/AWWA C153/A21.53 AWWA C605	AWWA Standard for Ductile-Iron Compact Fittings for Water Service Standard for Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings for Water
AWWA C651	Standard for Disinfecting Water Mains
AWWA C900	Standard for Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 in. through 12 in. (100mm Through 300mm), for Water Distribution
AWWA C905	Standard for Polyvinyl Chloride (PVC Pressure Pipe and Fabricated Fittings, 14 in. through 48 in. (350mm Through 1200mm), for Water Distribution and Transmission
AWWA M23	AWWA Manual of Supply Practices PVC Pipe—Design and Installation, Second Edition
ASTM C923	Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals
ASTM D1784	Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds
ASTM D1785	Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120 Test Method for Degree of Fusion of Extruded
ASTM D2152	Poly(Vinyl Chloride) (PVC) Pipe and Molded Fittings by Acetone Immersion
ASTM D2241	Poly (Vinyl Chloride) (PVC) Plastic Pipe (SDR-PR)
ASTM D2665	Poly (Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings
ASTM D3034	Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings
ASTM F477	Elastomeric Seals (Gaskets) for Joining Plastic Pipe
ASTM F679	Standard Specification for Poly(Vinyl Chloride) (PVC) Large Diameter Plastic Gravity Sewer Pipe and Fittings
ASTM F1057	Standard Practice for Estimating the Quality of Extruded Poly (Vinyl Chloride) (PVC) Pipe by the Heat Reversion Technique
ASTM F1417	Standard Test Method for Installation Acceptance of Plastic Gravity Sewer Lines Using Low-Pressure Air
UNI-B-6	Recommended Practice for Low-Pressure Air Testing of Installed Sewer Pipe
UNI-PUB-08	Tapping Guide for PVC Pressure Pipe
NSF-14	Plastics Piping System Components and Related Materials
NSF-61	Drinking Water System Components--Health Effects
PPI TR-2	PVC Range Composition Listing of Qualified Ingredients

B. Manufacturer Requirements

1. All piping shall be made from PVC compound conforming to cell classification 12454 per ASTM D1784.

C. FUSION TECHNICIAN REQUIREMENTS

1. Fusion Technician shall be fully certified by the pipe supplier to install fusible polyvinyl chloride pipe of the type(s) and size(s) being used. Certification shall be current as of the actual date of fusion performance on the project.

D. SPECIFIED PIPE SUPPLIERS

1. Fusible polyvinyl chloride pipe shall be used as manufactured under the trade names Fusible C-900®, Fusible C-905®, and FPVC®, for Underground Solutions, Inc., Poway, CA, (858) 679-9551. Fusion process shall be as patented by Underground Solutions, Inc., Poway, CA, Patent No. 6,982,051. Owner and Engineer are aware of no other supplier of fusible polyvinyl chloride pipe that is an equal to this specified pipe supplier and products.

E. WARRANTY

1. The pipe shall be warranted for two (2) year per the pipe supplier's standard terms.
2. In addition to the standard pipe warranty, the fusion services shall be warranted for two (2) year per the fusion service provider's standard terms.

F. PRE-CONSTRUCTION SUBMITTALS

1. The following PRODUCT DATA is required from the pipe supplier and/or fusion provider:
 - a Pipe Size (Nominal and Actual O.D. and I.D. (inches))
 - b Dimensionality
 - c Pressure Class per applicable standard
 - d Color
 - e Recommended Minimum Bending Radius (feet)
 - f Recommended Maximum Safe Pull Force (pounds)

- g Fusion technician qualification indicating conformance with this specification
2. The following WORK PLAN AND INFORMATION is required from the Contractor and/or pipe bursting Contractor, if requested. This WORK PLAN AND INFORMATION shall also be supplied to the pipe supplier, should it be requested:
 - a Pipe bursting equipment information and certification indicating the applicability of equipment, operator, and methods commensurate with the size and scope of the project, including any proposed lubricants to be used in the operation.
 - b Contingency plan, including the following:
 - c Unforeseen obstructions that stop or delay the operation
 - d Unforeseen deflections that would over bend the fusible polyvinyl chloride pipe
 - e Excessive surface heaving or subsidence
 - f Damage to existing utility installations
 - g Required spot repairs of the existing line
 3. Shop drawings shall include for each pipe bursting operation all excavation locations, interfering utilities, excavation dimensions, flow bypass and traffic control schematics.
 4. Work schedule identifying construction sequencing, daily work hours and working dates for each installation.

G. POST-CONSTRUCTION SUBMITTALS

1. The following AS-RECORDED DATA is required from the contractor and/or fusion provider to the Town or pipe supplier upon request:
 - a Approved datalogger device reports
 - b Fusion joint documentation containing the following information:
 - c Pipe Size and Thickness
 - d Machine Size
 - e Fusion Technician Identification

- f Job Identification
- g Fusion Joint Number
- h Fusion, Heating, and Drag Pressure Settings
- i Heat Plate Temperature
- j Time Stamp
- k Heating and Cool Down Time of Fusion
- l Ambient Temperature

PART 2 PRODUCTS

2.1 FUSIBLE POLYVINYL CHLORIDE PRESSURE PIPE FOR POTABLE WATER

- A. Fusible polyvinyl chloride pipe shall conform to AWWA C900, AWWA C905, ASTM D2241 or ASTM D1785 for standard dimensions, as applicable. Testing shall be in accordance with the referenced AWWA standards for all pipe types.
- B. Fusible polyvinyl chloride pipe shall be extruded with plain ends. The ends shall be square to the pipe and free of any bevel, chamfer or burrs. There shall be no bell or gasket of any kind incorporated into the pipe.
- C. Fusible polyvinyl chloride pipe shall be manufactured in a standard 40' nominal length, or custom lengths as specified.
- D. Fusible polyvinyl chloride pipe shall be blue in color for potable water use.
- E. Pipe shall be marked as follows:
 - 1. Nominal pipe size
 - 2. PVC
 - 3. Dimension Ratio, Standard Dimension Ratio, or Schedule
 - 4. AWWA pressure class, or standard pressure rating for non-AWWA pipe, as applicable
 - 5. AWWA standard designation number, or pipe type for non-AWWA pipe, as applicable
 - 6. NSF-61 mark verifying suitability for potable water service

7. Extrusion production-record code
 8. Trademark or trade name
 9. Cell Classification 12454 and/or PVC material code 1120 shall also be included
- F. Pipe shall be homogeneous throughout and be free of visible cracks, holes, foreign material, blisters, burrs, or other visible deleterious faults.

2.2 FUSIBLE POLYVINYL CHLORIDE PRESSURE PIPE FOR NON-POTABLE WATER NOT CONFORMING TO AWWA C905 DIMENSIONALITY

- A. Fusible polyvinyl chloride pipe shall conform to AWWA C900, ASTM D2241 or ASTM D1785 for standard dimensionality, as applicable. Testing shall be in accordance with the referenced AWWA standard.
- B. Fusible polyvinyl chloride pipe shall be extruded with plain ends. The ends shall be square to the pipe and free of any bevel or chamfer. There shall be no bell or gasket of any kind incorporated into the pipe.
- C. Fusible polyvinyl chloride pipe shall be manufactured in a standard 40' nominal length, or custom lengths as specified.
- D. Fusible polyvinyl chloride pipe shall be purple in color for reclaim, reuse, or other non-potable water distribution or conveyance.
- E. Pipe shall be marked as follows:
 1. Nominal pipe size
 2. PVC
 3. Dimension Ratio, Standard Dimension Ratio, or Schedule
 4. AWWA pressure class, or standard pressure rating for non-AWWA pipe, as applicable
 5. AWWA standard designation number, or pipe type for non-AWWA pipe, as applicable
 6. Extrusion production-record code
 7. Trademark or trade name
 8. Cell Classification 12454 and/or PVC material code 1120 shall also be included

9. For reclaim water service, the wording: “Reclaimed Water, NOT for Potable Use”

F. Pipe shall be homogeneous throughout and be free of visible cracks, holes, foreign material, blisters, burrs, or other visible deleterious faults.

2.3 FUSIBLE POLYVINYL CHLORIDE PRESSURE PIPE FOR NON-POTABLE WATER CONFORMING TO AWWA C905 DIMENSIONALITY

A. Fusible polyvinyl chloride pipe shall conform to AWWA C905 standard.

B. Fusible polyvinyl chloride pipe shall be extruded with plain ends. The ends shall be square to the pipe and free of any bevel, burrs or chamfer. There shall be no bell or gasket of any kind incorporated into the pipe.

C. Fusible polyvinyl chloride pipe shall be manufactured in a standard 40’ nominal length, or custom lengths as specified.

D. Fusible polyvinyl chloride pipe shall be purple in color for reclaim, reuse, or other non-potable water distribution or conveyance.

E. Pipe shall be marked as follows:

1. Nominal pipe size

2. PVC

3. Dimension Ratio, Standard Dimension Ratio, or Schedule

4. AWWA pressure class

5. AWWA standard designation number

6. Extrusion production-record code

7. Trademark or trade name

8. Cell Classification 12454 and/or PVC material code 1120 shall also be included

9. For reclaim water service, the wording: “Reclaimed Water, NOT for Potable Use”

10. Pipe shall be homogeneous throughout and be free of visible cracks, holes, foreign material, blisters, burrs, or other visible deleterious faults.

2.4 FUSIBLE POLYVINYL CHLORIDE PRESSURE PIPE FOR WASTEWATER NOT CONFORMING TO AWWA C905 DIMENSIONALITY

- A. Fusible polyvinyl chloride pipe shall conform to AWWA C900, ASTM D2241 or ASTM D1785 for standard dimensionality, as applicable. Testing shall be in accordance with the referenced AWWA standard.
- B. Fusible polyvinyl chloride pipe shall be extruded with plain ends. The ends shall be square to the pipe and free of any bevel chamfer, or burrs. There shall be no bell or gasket of any kind incorporated into the pipe.
- C. Fusible polyvinyl chloride pipe shall be manufactured in a standard 40' nominal length, or custom lengths as specified.
- D. Fusible polyvinyl chloride pipe shall be green in color for wastewater use.
- E. Pipe shall be marked as follows:
 - 1. Nominal pipe size
 - 2. PVC
 - 3. Dimension Ratio, Standard Dimension Ratio, or Schedule
 - 4. AWWA pressure class, or standard pressure rating for non-AWWA pipe, as applicable
 - 5. AWWA standard designation number, or pipe type for non-AWWA pipe, as applicable
 - 6. Extrusion production-record code
 - 7. Trademark or trade name
 - 8. Cell Classification 12454 and/or PVC material code 1120 shall also be included
 - 9. Pipe shall be homogeneous throughout and be free of visible cracks, holes, foreign material, blisters, or other visible deleterious faults.

2.5 FUSIBLE POLYVINYL CHLORIDE PRESSURE PIPE FOR WASTEWATER CONFORMING TO AWWA C905 DIMENSIONALITY

- A. Fusible polyvinyl chloride pipe shall conform to AWWA C905 standard.
- B. Fusible polyvinyl chloride pipe shall be extruded with plain ends. The ends shall be square to the pipe and free of any bevel, chamfer or burrs. There shall be no bell or gasket of any kind incorporated into the pipe.
- C. Fusible polyvinyl chloride pipe shall be manufactured in a standard 40' nominal length, or custom lengths as specified.

- D. Fusible polyvinyl chloride pipe shall be green in color for wastewater use.
- E. Pipe shall be marked as follows:
 - 1. Nominal pipe size
 - 2. PVC
 - 3. Dimension Ratio, Standard Dimension Ratio, or Schedule
 - 4. AWWA pressure class
 - 5. AWWA standard designation number
 - 6. Extrusion production-record code
 - 7. Trademark or trade name
 - 8. Cell Classification 12454 and/or PVC material code 1120 shall also be included
 - 9. Pipe shall be homogeneous throughout and be free of visible cracks, holes, foreign material, blisters, burrs, or other visible deleterious faults.

2.6 FUSIBLE POLYVINYL CHLORIDE NON-PRESSURE PIPE FOR WASTEWATER OR SURFACE WATER

- A. Fusible polyvinyl chloride pipe shall conform to ASTM D3034 or ASTM F679.
- B. Fusible polyvinyl chloride pipe may instead conform to AWWA C900 or AWWA C905, ASTM D2241 or ASTM D1785 for standard dimensionality, as applicable.
- C. Fusible polyvinyl chloride pipe shall be extruded with plain ends. The ends shall be square to the pipe and free of any bevel or chamfer. There shall be no bell or gasket of any kind incorporated into the pipe.
- D. Fusible polyvinyl chloride pipe shall be manufactured in a standard 40' nominal length, or custom lengths as specified.
- E. Fusible polyvinyl chloride pipe shall be green in color for wastewater use. Fusible polyvinyl chloride pipe shall be white in color for surface or storm water use.
- F. Pipe shall be marked as follows:
 - 1. Nominal pipe size

2. PVC
3. Dimension Ratio, Standard Dimension Ratio, or Schedule
4. Pressure class or standard pressure rating
5. Standard designation number or pipe type
6. Extrusion production-record code
7. Trademark or trade name
8. Cell Classification 12454 and/or PVC material code 1120 shall also be included
9. Pipe shall be homogeneous throughout and be free of visible cracks, holes, foreign material, blisters, or other visible deleterious faults.

2.7 FUSION JOINTS

- A. Unless otherwise specified, fusible polyvinyl chloride pipe lengths shall be assembled in the field with butt-fused joints. The Contractor shall follow the pipe supplier's written guidelines for this procedure. All fusion joints shall be completed as described in this specification.

2.8 CONNECTIONS AND FITTINGS FOR PRESSURE APPLICATIONS

- A. Connections shall be defined in conjunction with the coupling of project piping, as well as the tie-ins to other piping systems.

2.9 DUCTILE IRON MECHANICAL AND FLANGED FITTINGS

- A. Acceptable fittings for use with fusible polyvinyl chloride pipe shall include standard ductile iron fittings conforming to AWWA/ANSI C110/A21.10, or AWWA/ANSI C153/A21.53 and AWWA/ANSI C111/A21.11.
 1. Connections to fusible polyvinyl chloride pipe may be made using a restrained or non-restrained retainer gland product for PVC pipe, as well as for MJ or flanged fittings.
 2. Bends, tees and other ductile iron fittings shall be restrained with the use of thrust blocking or other means as indicated in the construction documents.
 3. Ductile iron fittings and glands must be installed per the manufacturer's guidelines.

2.10 PVC GASKETED, PUSH-ON FITTINGS

- A. Acceptable fittings for use with fusible polyvinyl chloride pipe shall include standard PVC pressure fittings conforming to AWWA C900 or AWWA C905.
 - 1. Acceptable fittings for use joining fusible polyvinyl chloride pipe other sections of fusible polyvinyl chloride pipe or other sections of PVC pipe shall include gasketed PVC, push-on type couplings and fittings, including bends, tees, and couplings as shown in the drawings.
 - 2. Bends, tees and other PVC fittings shall be restrained with the use of thrust blocking or other restraint products as indicated in the construction documents.
 - 3. PVC gasketed, push-on fittings and mechanical restraints, if used, must be installed per the manufacturer's guidelines.

2.11 FUSIBLE POLYVINYL CHLORIDE SWEEPS OR BENDS

- A. Fusible polyvinyl chloride sweeps or bends shall conform to the same sizing convention, diameter, dimensional tolerances and pressure class of the pipe being joined using the sweep or bend.
- B. Fusible polyvinyl chloride sweeps or bends shall be manufactured from the same fusible polyvinyl chloride pipe being used for the installation, and shall have at least 2 feet of straight section on either end of the sweep or bend to allow for fusion of the sweep to the pipe installation. There shall be no gasketed connections utilized with a fusible polyvinyl chloride sweep.
- C. Standard fusible polyvinyl chloride sweep or bend angles shall not be greater than 22.5 degrees, and shall be used in nominal diameters ranging from 4 inch through 16 inch.

2.12 SLEEVE-TYPE COUPLINGS

- A. Sleeve-type mechanical couplings shall be manufactured for use with PVC pressure pipe, and may be restrained or unrestrained as indicated in the construction documents.
- B. Sleeve-type couplings shall be rated at the same or greater pressure carrying capacity as the pipe itself.

2.13 EXPANSION AND FLEXIBLE COUPLINGS

- A. Expansion-type mechanical couplings shall be manufactured for use with PVC pipe, and may be restrained or unrestrained as indicated in the construction documents.

- B. Expansion-type mechanical couplings shall be rated at the same or greater pressure carrying capacity as the pipe itself.

2.14 CONNECTION HARDWARE

- A. Bolts and nuts for buried service shall be made of non-corrosive, high-strength, low-alloy steel having the characteristics specified in ANSI/AWWA C111/A21.11, regardless of any other protective coating.

2.15 CONNECTIONS FOR GRAVITY SANITARY SEWER AND NON-PRESSURE APPLICATIONS

- A. The following connections are to be used in conjunction with tie-ins to other non-pressure, gravity sewer piping and/or structures, and shall be as indicated in the construction documents.

2.16 PVC GASKETED, PUSH-ON COUPLINGS

- A. Acceptable couplings for joining fusible polyvinyl chloride pipe to other sections of fusible polyvinyl chloride pipe or other sections of PVC pipe shall include gasketed PVC, push-on type couplings as indicated in the construction documents.
- B. PVC gasketed, push-on fittings and/or restraint hardware must be installed per the manufacturer's guidelines.

2.17 FUSIBLE POLYVINYL CHLORIDE SWEEPS OR BENDS

- A. Fusible polyvinyl chloride sweeps or bends shall conform to the same sizing convention, diameter, dimensional tolerances and pressure class of the pipe being joined using the sweep or bend.
- B. Fusible polyvinyl chloride sweeps or bends shall be manufactured from the same fusible polyvinyl chloride pipe being used for the installation, and shall have at least 2 feet of straight section on either end of the sweep or bend to allow for fusion of the sweep to the pipe installation. There shall be no gasketed connections utilized with a fusible polyvinyl chloride sweep.
- C. Standard fusible polyvinyl chloride sweep or bend angles shall not be greater than 22.5 degrees, and shall be used in nominal diameters ranging from 4 inch through 16 inch.

2.18 SLEEVE-TYPE COUPLINGS

- A. Sleeve-type mechanical couplings shall be manufactured for use with PVC pipe, and may be restrained or unrestrained as indicated in the construction documents.

2.19 EXPANSION AND FLEXIBLE COUPLINGS

- A. Expansion-type mechanical couplings shall be manufactured for use with PVC pipe, and may be restrained or unrestrained as indicated in the construction documents.

2.20 CONNECTION HARDWARE

- A. Bolts and nuts for buried service shall be made of non-corrosive, high-strength, low-alloy steel having the characteristics specified in ANSI/AWWA C111/A21.11, regardless of any other protective coating.

2.21 CONNECTION TO SANITARY SEWER MANHOLES AND STRUCTURES

- A. Fusible polyvinyl chloride pipe shall be connected to manholes and other structures to provide a leak-free, properly graded flow into or out of the manhole or structure.
- B. Connections to existing manholes and structures shall be as indicated in the construction documents.
 - 1. For a cored or drilled opening provide a flexible, watertight connection that meets and/or exceeds ASTM C923.
 - 2. For a knock out opening, provide a watertight connection (waterstop or other method) meeting the material requirements of ASTM C923 that is securely attached to the pipe with stainless steel bands or other means.
 - 3. Grout opening in manhole wall with non-shrink grout. Pour concrete collar around pipe and outside manhole opening. Provide flexible pipe joint or flexible connector within 2 feet of the collar.
- C. Connections to a new manhole or structure shall be as indicated in the construction documents.
 - 1. A flexible, watertight gasket per ASTM C 923 shall be cast integrally with riser section(s) for all precast manhole and structures.
 - 2. Drop connections shall be required where shown on drawings.
 - 3. Grout internal joint space with non-shrink grout.

2.22 PIPE BURSTING SYSTEM EQUIPMENT

- A. GENERAL

1. The pipe bursting system shall be designed and manufactured to force its way through the existing line by fragmenting the pipe and compressing the broken pieces into the surrounding soil as its progresses. The bursting unit shall generate sufficient force to burst and compact the existing pipeline and allow for the insertion of the fusible polyvinyl chloride pipe.

B. ALLOWABLE TYPES OF PIPE BURSTING SYSTEMS

1. STATIC PIPE BURSTING SYSTEMS

- a Static pipe bursting systems shall be characterized by a tapered or blunt nosed pull head being pulled through the host pipe and breaking the host pipe by applying radial pressure to the host pipe. The host pipe fails by ‘hoop’ tensile stress applied by the head, and is fragmented and pushed into the surrounding bedding and soil as the pull head progresses.
- b The pull head shall be followed by an expansion head which shall further push the fragmented pipe into the surrounding soil and bedding to a diameter that allows the insertion of the fusible polyvinyl chloride pipe behind it. Under no circumstances shall the pipe pull head, which is attached directly to the fusible polyvinyl chloride pipe, be used to expand or otherwise increase the diameter of the host pipe, or fragmented host pipe.
- c The pull head may be advanced by a hydraulic or winching mechanism, and may be connected by means of a cable, chain, or rod.

2. HYDRAULIC PIPE BURSTING SYSTEMS

- a Hydraulic pipe bursting systems shall be characterized by a pull head that is equipped with hydraulically actuated ‘petals’ that break the host pipe by applying radial pressure to the host pipe. The host pipe fails by ‘hoop’ tensile stress applied by the head, and is fragmented and pushed into the surrounding bedding and soil as the pull head progresses.
- b The pull head shall be followed by an expansion head which shall further push the fragmented pipe into the surrounding soil and bedding to a diameter that allows the insertion of the fusible polyvinyl chloride pipe behind it. Under no circumstances shall the pipe pull head, which is attached directly to the fusible polyvinyl chloride pipe, be used to

expand or otherwise increase the diameter of the host pipe, or fragmented host pipe.

- c The pull head may be advanced by a hydraulic or winching mechanism, and may be connected by means of a cable, chain, or rod.

3. UNDER NO CIRCUMSTANCES WILL PNEUMATIC OR PERCUSSIVE BURSTING SYSTEMS BE ALLOWED.

4. BURSTING LUBRICANTS

- a Bursting lubricants shall be used at the request of the pipe bursting contractor and at the discretion of the Owner and Engineer.
- b Lubricants shall be compatible for long term use with PVC plastic.

2.23 PIPE PULL HEADS

- A. Pipe pull heads shall be utilized that employ a positive through-bolt design assuring a smooth wall against the pipe cross-section at all times.
- B. Pipe pull heads shall be specifically designed for use with fusible polyvinyl chloride pipe, and shall be as recommended by the pipe supplier.

2.24 PIPE ROLLERS

- A. Pipe rollers, if required, shall be of sufficient size to fully support the weight of the pipe during handling and pullback operations.
- B. A sufficient quantity of rollers and spacing, per the pipe supplier's guidelines shall be used to assure adequate support and resist excessive sagging of the product pipe.

PART 3 EXECUTION

3.1 DELIVERY AND OFF-LOADING

- A. All pipes shall be bundled or packaged in such a manner as to provide adequate protection of the ends during transportation to the site. Any pipe damaged in shipment shall be replaced as directed by the owner or engineer.
- B. Each pipe shipment should be inspected prior to unloading to see if the load has shifted or otherwise been damaged. Notify owner or engineer immediately if more than immaterial damage is found. Each pipe shipment should be checked for quantity and proper pipe size, color, and type.

- C. Pipe should be loaded, off-loaded, and otherwise handled in accordance with AWWA M23, and all of the pipe supplier's guidelines shall be followed.
- D. Off-loading devices such as chains, wire rope, chokers, or other pipe handling implements that may scratch, nick, cut, or gouge the pipe are strictly prohibited.
- E. During removal and handling, be sure that the pipe does not strike anything. Significant impact could cause damage, particularly during cold weather.
- F. If appropriate unloading equipment is not available, pipe may be unloaded by removing individual pieces. Care should be taken to insure that pipe is not dropped or damaged. Pipe should be carefully lowered, not dropped, from trucks.

3.2 HANDLING AND STORAGE

- A. Any length of pipe showing a crack or which has received a blow that may have caused an incident fracture, even though no such fracture can be seen, shall be marked as rejected and removed at once from the work. Damaged areas, or possible areas of damage may be removed by cutting out and removing the suspected incident fracture area. Limits of the acceptable length of pipe shall be determined by the owner or engineer.
- B. Any scratch or gouge greater than 10% of the wall thickness will be considered significant and can be rejected unless determined acceptable by the owner or engineer.
- C. Pipe lengths should be stored and placed on level ground. Pipe should be stored at the job site in the unit packaging provided by the manufacturer. Caution should be exercised to avoid compression, damage, or deformation to the ends of the pipe. The interior of the pipe, as well as all end surfaces, should be kept free from dirt and foreign matter.
- D. Pipe shall be handled and supported with the use of woven fiber pipe slings or approved equal. Care shall be exercised when handling the pipe to not cut, gouge, scratch or otherwise abrade the piping in any way.
- E. If pipe is to be stored for periods of 1 year or longer, the pipe should be shaded or otherwise shielded from direct sunlight. Covering of the pipe which allows for temperature build-up is strictly prohibited. Pipe should be covered with an opaque material while permitting adequate air circulation above and around the pipe as required to prevent excess heat accumulation.
- F. Pipe shall be stored and stacked per the pipe supplier's guidelines.

3.3 FUSION PROCESS

A. GENERAL

1. Fusible polyvinyl chloride pipe will be handled in a safe and non-destructive manner before, during, and after the fusion process and in accordance with this specification and pipe supplier's guidelines.
2. Fusible polyvinyl chloride pipe will be fused by qualified fusion technicians, as documented by the pipe supplier.
3. Each fusion joint shall be recorded and logged by an electronic monitoring device (data logger) connected to the fusion machine.
4. Only appropriately sized and outfitted fusion machines that have been approved by the pipe supplier shall be used for the fusion process. Fusion machines must incorporate the following elements:
 - a. HEAT PLATE - Heat plates shall be in good condition with no deep gouges or scratches. Plates shall be clean and free of any debris or contamination. Heater controls shall function properly; cord and plug shall be in good condition. The appropriately sized heat plate shall be capable of maintaining a uniform and consistent heat profile and temperature for the size of pipe being fused, per the pipe supplier's guidelines.
 - b. CARRIAGE – Carriage shall travel smoothly with no binding at less than 50 psi. Jaws shall be in good condition with proper inserts for the pipe size being fused. Insert pins shall be installed with no interference to carriage travel.
 - c. GENERAL MACHINE - Overview of machine body shall yield no obvious defects, missing parts, or potential safety issues during fusion.
 - d. DATA LOGGING DEVICE – An approved datalogging device with the current version of the pipe supplier's recommended and compatible software shall be used. Datalogging device operations and maintenance manual shall be with the unit at all times. If fusing for extended periods of time, an independent 110V power source shall be available to extend battery life.
5. Other equipment specifically required for the fusion process shall include the following:
 - a. Pipe rollers shall be used for support of pipe to either side of the machine

- b A weather protection canopy that allows full machine motion of the heat plate, fusion assembly and carriage shall be provided for fusion in inclement, extreme temperatures, and /or windy weather, per the pipe supplier's recommendations.
- c An infrared (IR) pyrometer for checking pipe and heat plate temperatures.
- d Fusion machine operations and maintenance manual shall be kept with the fusion machine at all times.
- e Facing blades specifically designed for cutting fusible polyvinyl chloride pipe shall be used.

B. JOINT RECORDING

1. Each fusion joint shall be recorded and logged by an electronic monitoring device (data logger) connected to the fusion machine. The fusion data logging and joint report shall be generated by software developed specifically for the butt-fusion of fusible polyvinyl chloride pipe. The software shall register and/or record the parameters required by the pipe supplier and these specifications. Data not logged by the data logger shall be logged manually and be included in the Fusion Technician's joint report.

3.4 CLEANING AND TV INSPECTION OF EXISTING PIPELINE

- A. The host pipe shall be cleaned and inspected by TV prior to the bursting operation in accordance with, and if required by the contract documents.
- B. Cleaning and TV inspection of the host pipe shall indicate condition of host pipe and suitability of host pipe for fusible polyvinyl chloride pipe insertion by pipe bursting methods.
- C. Obstructions considered detrimental to the pipe bursting operation which may include corporation taps, valves and valve bodies, and collapsed piping shall be remedied prior to bursting and fusible polyvinyl chloride pipe insertion.
- D. Spot repairs shall be made in accordance with the drawings and these specifications.

3.5 BURSTING OPERATIONS AND PIPE INSTALLATION

A. LOCATION AND PROTECTION OF UNDERGROUND UTILITIES

1. Correct location of all underground utilities that may impact the installation is the responsibility of the Contractor.
2. Utility location and notification services shall be contacted by the Contractor prior to the start of construction.
3. All existing lines and underground utilities shall be positively identified, including exposing those facilities that are located within an envelope of possible impact of the bursting operation as determined for the project specific site conditions. It is the Contractor and pipe burst system operator's responsibility to determine this envelope of safe burial depth and offset from existing utilities. This will include, but is not limited to soil conditions and layering, utility proximity and material, pipe bursting system and equipment, and foreign subsurface material.

B. EXCAVATION AND ACCESS PITS

1. Access pit length shall be such that the minimum bending radius for the fusible polyvinyl chloride pipe, per the pipe supplier is maintained. Sheeting, shoring and bracing requirements shall be in accordance with these specifications and applicable jurisdictional standards.
2. Access pit excavations shall be performed at all points where the fusible polyvinyl chloride pipe will be inserted into the existing pipeline. When possible, access pit excavations shall coincide with host pipe lateral connection points or other appurtenance installations.
3. The fusible polyvinyl chloride pipe may be continuously or partially supported on rollers or other Owner and Engineer approved friction decreasing implement during joining and insertion, as long as the pipe is not over-stressed or critically abraded prior to or during installation.

C. PIPE BURSTING OPERATION

1. Any known pre-existing concrete encasements shall be excavated and broken out prior to the bursting operation to allow the steady and free passage of the pipe bursting head.
2. The new fusible polyvinyl chloride pipe shall be inserted immediately behind the bursting head in accordance with the pipe supplier's recommended procedures. The bursting equipment shall be specifically designed and manufactured for the type of insertion process being used.
3. Immediately following the completion of a pipe bursting installation, if possible, the pipe should be pushed back into the location of the insertion, at the pulling head, until a small amount of movement is realized at the

insertion pit on the other side of the installation from the pulling equipment.

D. FUSIBLE POLYVINYL CHLORIDE PIPE CARE

1. The fusible polyvinyl chloride pipe shall be handled with care to minimize the possibility of it being cut, kinked, gouged, or otherwise damaged. The use of cables or hooks in direct contact with the pipe will not be permitted.
2. Sections of the fusible polyvinyl chloride pipe damaged, cut, or gouged shall be repaired by cutting out the section of damaged pipe and then rejoining per the construction documents and the pipe supplier's guidelines.

3.6 INSTALLATION ACCEPTANCE AND CLEANUP

- A. The first several feet of fusible polyvinyl chloride pipe that is pulled into the receiving pit behind the pull head shall be inspected for damage. Depending on the gouging, abrading or damage witnessed the pipe may be accepted, de-rated, reinstalled, or abandoned as unusable per the contract documents.
- B. Following the installation, the project site shall be returned to a condition equal to or better than the pre-construction condition of the site. All excavations will be backfilled and compacted per the construction documents, and jurisdictional standards. All pavement and hardscape shall be repaired per applicable jurisdictional standards, excess materials shall be removed from the site, and disturbed areas shall be re-landscaped.
- C. Contractor shall verify that all utilities, structures, and sub-surface features within the envelope of possible impact of the bursting operation as determined for the project specific site conditions are sound.

3.7 PREPARATION PRIOR TO MAKING CONNECTIONS INTO EXISTING PIPING SYSTEMS

- A. Approximate locations for existing piping systems are shown in the construction documents. Prior to making connections into existing piping systems, the contractor shall:
 1. Field verify location, size, piping material, and piping system of the existing pipe.
 2. Obtain all required fittings, which may include saddles, sleeve type couplings, flanges, tees, or others as shown in the construction documents.
 3. Have installed all temporary pumps and/or pipes in accordance with established connection plans.

- B. Unless otherwise approved, new piping systems shall be completely assembled and successfully tested prior to making connections into existing pipe systems.

3.8 PIPE SYSTEM CONNECTIONS

- A. Pipe connections shall be installed per applicable standards and regulations, as well as per the connection manufacturer's guidelines and as indicated in the construction documents. Pipe connections to structures shall be installed per applicable standards and regulations, as well as per the connection manufacturer's guidelines.

3.9 TAPPING FOR POTABLE AND NON-POTABLE WATER APPLICATIONS

- A. Tapping shall be performed using standard tapping saddles designed for use on PVC piping in accordance with AWWA C605. Tapping shall be performed only with use of tap saddles or sleeves. **NO DIRECT TAPPING WILL BE PERMITTED.** Tapping shall be performed in accordance with the applicable sections for Saddle Tapping per Uni-Pub-8.
- B. All connections requiring a larger diameter than that recommended by the pipe supplier, shall be made with a pipe connection as specified and indicated on the drawings.
- C. Equipment used for tapping shall be made specifically for tapping PVC pipe:
 - 1. Tapping bits shall be slotted "shell" style cutters, specifically made for PVC pipe. 'Hole saws' made for cutting wood, steel, ductile iron, or other materials are strictly prohibited.
 - 2. Manually operated or power operated drilling machines may be used.
- D. Taps shall be performed when the pipeline is not filled with water and not under pressure ('dry' tap).

3.10 TESTING

- A. Testing shall comply with all applicable jurisdictional building codes, statutes, standards, regulations, and laws.
- B. **HYDROSTATIC TESTING AND LEAKAGE TESTING FOR PRESSURE PIPING**
 - 1. Hydrostatic and leakage testing for piping systems that contain mechanical jointing as well as fused PVC jointing shall comply with AWWA C605.

2. Unless agreed to or otherwise designated by the owner or engineer, for a simultaneous hydrostatic and leakage test following installation, a pressure equal to 150% of working pressure at point of test, but not less than 125% of normal working pressure at highest elevation shall be applied. The duration of the pressure test shall be for two (2) hours.
3. If hydrostatic testing and leakage testing are performed at separate times, follow procedures as outlined in AWWA C605.
4. In preparation for pressure testing the following parameters must be followed:
 - a All air must be vented from the pipeline prior to pressurization. This may be accomplished with the use of the air relief valves or corporation stop valves, vent piping in the testing hardware or end caps, or any other method which adequately allows air to escape the pipeline at all high points. Venting may also be accomplished by 'flushing' the pipeline in accordance with the parameters and procedures as described in AWWA C605.
 - b The pipeline must be fully restrained prior to pressurization. This includes complete installation of all mechanical restraints per the restraint manufacturer's guidelines, whether permanent or temporary to the final installation. This also includes the installation and curing of any and all required thrust blocking. All appurtenances included in the pressure test, including valves, blow-offs, and air-relief valves shall be checked for proper installation and restraint prior to beginning the test.
5. Temporary pipeline alignments that are being tested, such as those that are partially installed in their permanent location shall be configured to minimize the amount of potentially trapped air in the pipeline.

3.11 LEAKAGE TESTING FOR NON-PRESSURE PIPING

- A. Gravity sanitary sewers that contain mechanical jointing in addition to fused PVC joints may need to be tested for excessive leakage.
- B. Gravity sanitary sewer leakage testing may include appropriate water or low pressure air testing. The leakage outward or inward (exfiltration or infiltration) shall not exceed 25 gallons per inch of pipe diameter per mile per day for any section of the system. An exfiltration or infiltration test shall be performed with a minimum positive head of two feet. The air test, if used, shall be conducted in accordance with one of the following Standards:

1. ASTM F1417

2. UNI-B-6

C. The testing method selected shall properly consider the existing groundwater elevations during the test.

D. DEFLECTION TESTING FOR NON-PRESSURE PIPING

1. After completion of the backfill, the engineer or owner may require that a deflection test be performed.

2. Deflection tests should be conducted using a go/no-go mandrel. The mandrel's outside dimension shall be sized to permit no more than 7.5 percent deflection. The percent deflection shall be established from the base inside diameter of the pipe. If the internal beading of the fused joints for the pipe is not required to be removed, the mandrel shall account for this clearance as well. The mandrel shall be approved by the owner or engineer prior to use. Lines that permit safe entry may allow other deflection test options, such as direct measurements.

E. DISINFECTION OF THE PIPELINE FOR POTABLE WATER PIPING

1. After installation, the pipeline, having passed all required testing, shall be disinfected prior to being put into service. Unless otherwise directed by the owner or engineer, the pipeline will be disinfected per AWWA C651.

F. PARTIAL TESTING

1. Segments of the pipe may be tested separately in accordance with standard testing procedure, as approved by the owner and engineer.

****END OF SECTION****

SECTION 02641

VALVES

PART 1 GENERAL

1.1 DESCRIPTION

A. This section covers valves, valve operators, valve boxes, and appurtenances used for water distribution and transmission system.

1.2 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Take precautions so as not to damage materials during delivery or storage.

B. Store valves off the ground and away from materials that could contaminate potable water systems.

C. Take precautions to keep joints and internal parts clean.

PART 2 PRODUCTS

2.1 GENERAL

A. Direction of opening: open counterclockwise (left)

B. Operating nut: Two (2) inch square.

C. Markings

1. Paint operating nuts in accordance with AWWA C509 & C515.

a Red = clockwise (right)

b Black = counter clockwise (left)

2. Mark centering ring with directional arrow indicating direction for opening of valve.

a Fabricate directional arrow permanently into centering ring.

D. Valves shall be capable of satisfactory operation with flow in either direction.

E. Generally, valves 12 inches and smaller in diameter shall be gate valves. Town may require butterfly valves at certain locations.

2.2 GATE VALVES

A. Conformance: AWWA C509 or C515

1. Type: resilient seat
2. Coating: epoxy-coated interior and exterior
3. Stem seals: two O-ring seals in accordance with Section 4.8 of AWWA C509.
4. Ends: mechanical joint.
5. Hydrant valve ends: flanged by swivel.

2.3 CORPORATION STOPS

A. For use with Air Release and Vacuum Valves, only.

B. Corporation stops shall conform to AWWA C800, except must be capable of operating at a working pressure of 150 psi.

1. Corporation stops shall be constructed of brass.
2. Corporation stop inlet threads shall be "cc" type only.
3. Corporation stop outlet threads shall be IP type only.

C. Manufacturers:

1. Mueller
2. Ford
3. There will be no substitutes allowed.

2.4 CURB STOPS

A. Conform to AWWA C800 up to 2 inches in size. Curb stops larger than 2 inches in size shall be gate valves. Curb stop boxes are required with curb stops.

B. All curb stops shall have compression connections at both ends. All fitting connections shall contain like materials.

C. The top threads for all curb boxes of adjustable height.

D. Manufactures:

1. Ford, Mueller, or A-Y McDonalds compression type only.
2. Or as approved by the Town.

E. Curb stops with weep holes are not allowed.

2.5 AIR RELIEF/VACUUM RELIEF VALVES

A. Materials and Construction

1. Type: integral type assembly which functions both as an air release and vacuum valve.
2. Rating: working pressure of 50 psi min. and a hydrostatic test pressure of 250 psi.
3. Size: as determined by Engineer subject to Town Approval.
4. Connections:
 - a Inlet: threaded.
 - b Outlet: threaded, protect to minimize entry of debris and dirt.
5. Body: cast iron or ductile iron.
6. Working parts and seats: brass, stainless steel, or non-corroding material.
7. Float: non-corroding, high resilience, stainless steel.
8. Watertight at 150 psi.

B. Acceptable Manufacturers.

1. Crispin Universal Air Valve, by Multiplex Manufacturing.
2. Apco Combination Air Release Valve, by Valve and Primer Corporation.
3. CAV Combination Air Release and Vacuum Valve, G.A. Industries Inc.
4. Or approved equal.

2.6 VALVE BOXES

A. Cast iron or ductile iron 5 1/4 inch screw type box, including fire hydrant valves.

1. Capable of future adjustment for overlays.

2. Manufacture: Tyler, 6860 series #6 base and 6860 series box.
3. Furnish with suitable cast iron bases and covers.

2.7 BLOW-OFF ASSEMBLIES

- A. Six (6) inch in-line type or end-of-line type of blow-off assembly in accordance with the Standard Drawings is required at locations noted on the plans and at such additional locations as required by the Engineer for the removal of water or sediment from the pipeline.

PART 3 EXECUTION

3.1 GENERAL

- A. Valves and valve boxes shall be examined for cracks, dents, abrasions, and other flaws prior to installation.
 1. Mark and remove defective valves and valve boxes from the site.

3.2 VALVES

- A. Join valves in the same manner used to join fittings.
- B. Install with operating nut perpendicular to pipe.
- C. Support the joined valve in place on compacted granular material.
- D. Mount butterfly valve operators to south or west of the valve.

3.3 VALVE BOXES

- A. Install on all buried valves.
- B. Install so that no stress is transmitted to valve.
- C. Set plumb and directly over the nut. Confirm box is plumb at time of Construction Acceptance.
- D. Set top of box 1/4 inch below the finished surface on paved surfaces, six inches below finished grade in gravel surfacing, and at grade in other locations.
- E. Carefully compact soil around barrel with hand equipment, to prevent misalignment and settling of the backfill.
- F. Concrete collars shall be installed around all valve boxes as shown on Detail 2-11.

3.4 AIR RELEASE AND VACUUM VALVES

- A. Install at all high points in line. Distances between successive air release valves or successive vacuum valves shall not exceed 1/4 mile on pipes larger than eight (8) inches in size.

3.5 BLOW-OFF ASSEMBLIES

- A. The blow-off assembly shall be installed in a level section of pipe. The tap for blow-off in the line shall be no closer than 18 inches to a valve, coupling, or joint of fitting unless it is at the end of the main. Blow-offs shall be installed in accordance with Standard Drawing and the applicable sections of these Specifications. Blow-offs shall not be connected to any sewer, submerged in any stream, or installed in any manner that will permit back-siphonage into the distribution system. All material shall conform to the applicable requirements of these Specifications and as specified elsewhere herein.

3.6 OPERATION

- A. Operation of valves shall be only by the Town after Substantial Completion.

* * * END OF SECTION * * *

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SECTION 02644
FIRE HYDRANTS

PART 1 GENERAL

1.1 DESCRIPTION

1. This Section covers dry-barrel fire hydrants.

1.2 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Fire hydrants shall be handled, stored, and protected in such a manner as to prevent damage to materials, coatings, and finishes.
- B. Fittings and joints shall be kept free from dirt, oil and grease.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable manufacturers

1. Waterous by American Flow Control, Pacer Model, Traffic Model WB67-250 or as approved by the Town

2.2 MATERIALS AND CONSTRUCTION

- A. Type: dry barrel with breakaway flange designed for a working pressure of 150 psi, minimum.
- B. Conform to AWWA C502
- C. Outlet size: 1 - 4 ½ inch pumper nozzle and 2 - 2 ½ inch hose nozzles.
- D. Outlet threads: National Standard
- E. Main valve size: 5 1/4 inch.
- F. Shoe inlets: 6 inches with mechanical joint fitting
- G. Bury: 5 feet
- H. Operation: open left (counter clockwise)
- I. Color: yellow

- J. Operating nut: pentagonal
- K. The auxiliary gate valve on the hydrant lateral shall be a 6-inch resilient seat gate valve with a valve box, reference Section 02641.
- L. The hydrant tee on the main line shall be a swivel tee.

2.3 HYDRANT GRAVEL

- A. Hydrant gravel shall be well graded crushed stone or gravel, conforming to ASTM-D448, #67 (also CDOT #67) as listed below:

<u>SIZE</u>	<u>PERCENT PASSING</u>
1"	100
3/4"	90 - 100
3/8"	20 - 55
#4	0 - 10
#8	0 - 5

- B. Or well graded 3/4" angular rock.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Set plumb with nozzles parallel with, or at right angles to, the curb, with the pumper nozzle facing the curb, or as directed by Town.
- B. Set traffic flange 2 inches above finished grade.
- C. Hydrants shall be fully closed or fully opened. Do NOT operate hydrants in partially open mode.
- D. Provide offset staking for both vertical and horizontal control of placement.
- E. The joining of laterals, valves, and hydrants shall be handled in the same manner as pipe.
 - 1. The hydrant shall be set to the elevation staked, to insure that the bury line is at the final grade.
- F. The hydrant shall be supported on a minimum of 18 inches of compacted hydrant gravel.
 - 1. The hydrant shall be supported with a concrete block.

- G. A concrete thrust block, with a minimum bearing surface area as shown on the Drawings, shall be placed behind the hydrant shoe.
 - 1. A sheet of 8 mil polyethylene film shall be placed between hydrant shoe and concrete thrust block.
 - 2. Care shall be taken when placing thrust blocks so that hydrant drain holes remain free of obstructions.
- H. After pouring the thrust block, hydrant gravel shall be placed to a depth of 12" above the hydrant shoe.
 - 1. Hydrant drain holes shall remain free of obstructions.
- I. After installation of the hydrant is complete, the oil/ grease reservoir shall be checked to insure that it is full.
 - 1. If it is necessary to fill the reservoir, it shall be filled with the oil/grease which is specified by the hydrant manufacturer.
- J. Dependent upon the soil conditions and the length of the hydrant run, the fittings and pipe lengths may require rodding as determined by the Town.
- K. Cover hydrants with acceptable locking hydrant covers after installation until acceptance by Town.

3.2 LOCATION

- A. Hydrants in the public Right-Of-Way shall be located at least one (1) foot inside the ROW from the property line and shall conform to one of the following conditions.
 - 1. When placed behind the curb, the hydrant barrel shall be set so that no portion of the pumper or hose nozzle cap will be less than twenty-four (24) inches nor more than thirty (30) inches horizontal distance from the gutter face of the curb.
 - 2. When set in the lawn space between the curb and the sidewalk, or between the sidewalk and the property line, no portion of the hydrant or nozzle cap shall be within six (6) inches of the sidewalk, or no greater than eighteen (18) inches from the sidewalk.
 - 3. There shall not be a post, fence, vehicle, growth, trash, storage, or other material within 3 feet of a fire hydrant, except as otherwise approved by the Wellington Fire Protection District.

4. The ground surrounding the fire hydrant shall slope away from the hydrant at a minimum grade of 2% for five (5) feet.

* * * END OF SECTION * * *

SECTION 02713
WATER DISTRIBUTION AND TRANSMISSION SYSTEM

PART 1 GENERAL

1.1 DESCRIPTION

A. This section covers the installation of water distribution and transmission lines.

1.2 QUALITY ASSURANCE

A. Do not deviate from alignment more than 0.5 feet.

B. Do not deviate from grade so as to cause a reverse slope in any one pipe section between vertical points of intersections shown on the Drawings.

C. Conform to the regulations for installation of the Colorado Department of Public Health and Environment (CDPHE), and the Water Quality Control Commission.

1.3 JOB CONDITIONS

A. Precautions shall be taken to protect the interiors of pipes, fittings, and valves against contamination.

B. Pipe delivered for construction shall be strung so as to minimize entrance of foreign material.

C. All openings in the pipeline shall be closed with watertight plugs when pipe laying is stopped at the close of a day's work or for other reasons, such as rest breaks or meal periods.

D. Do not place debris, tools, clothing, or other material in the pipe.

E. Use effective measures to prevent uplifting or floating of the pipeline prior to completion of backfilling operations.

F. Do not install pipe under the following conditions:

1. When the trench contains water.

2. When weather conditions are unsuitable.

a Temperature is less than negative five (-5) degrees Fahrenheit.

- b Snowing.
- c Raining.
- d High winds.

3. When the trench bottom is unstable.

G. Protect pipe and appurtenances against dropping and damage.

- 1. Do not use pipe and appurtenances if they are damaged.

PART 2 PRODUCTS

2.1 CORROSION PROTECTION

- A. Protecto wrap tape, #200 or 200A.

2.2 PIPE

- A. Ductile iron pipe: reference Section 02615.
- B. Polyvinyl chloride pipe: reference Section 02621.

2.3 FUSED POLYVINYL CHLORIDE PIPE

- A. Reference Section 02623

2.4 VALVES

- A. Reference Section 02641

2.5 HYDRANTS

- A. Reference Section 02644.

2.6 COUPLINGS

- A. Reference Section 02615.

2.7 CONCRETE

- A. Reference section 02520 Division 5.

2.8 MECHANICAL JOINTS

- A. Restrained joint gland connections shall be made at all mechanical joints.

PART 3 EXECUTION

3.1 PREPARATION

- A. Perform trenching, backfilling and compacting in accordance with Section 02221.

3.2 INSPECTION

- A. Confirm pipe barrel and fittings are free of dirt or other foreign objects prior to installation.
- B. Inspect pipe and fittings for cracks, dents, abrasions or other flaws prior to installation.
- C. Damaged pipe, fitting, linings or coatings shall be rejected.
 - 1. Mark defective pipe and store on site at a separate location away from the work until after acceptance of the piping system at which time it shall be removed from the site.

D. Operational Inspection:

- 1. At the completion of the project and in the presence of the Town, the Contractor shall operate all valves, hydrants, and water services to ascertain that the entire facility is in good working order; that all valve boxes are centered and valves are opened; that all hydrants operate and drain properly; that all curb boxes are plumb centered; and that water is available at all curb stops.

3.3 CONNECTIONS TO EXISTING SYSTEM

- A. When connecting to the existing water system. Valves on the existing system shall be operated by the Town only. The Contractor shall provide at least forty-eight (48) hours notification prior to needing any valve operated, except in the case of emergencies.
- B. At locations where connections to existing water mains are to be installed, the Contractor shall locate the existing mains both vertically and horizontally and verify their exact size and material in advance of the time scheduled for making the connections.
 - 1. Prior to connecting to existing water mains, the Contractor shall have all men, materials, and equipment ready to connect the fitting to the existing main, so as to keep the shutoff time to a minimum.

2. Town will examine the existing pipe or appurtenance and specify any necessary adjustments in line, grade, or connection requirements to accomplish the connection.
 3. Use effective measures to prevent contamination to existing water lines.
 4. Swab the interior of new pipe, fittings, and valves installed in existing pipelines with a solution of one (1) percent (10,000 ppm) chlorine solution prior to installation.
 5. Only Town shall operate existing valves, hydrants, and other control units.
 6. As soon as possible after making the connections, the Contractor shall flush the connection so as to prevent contamination of the existing facilities. The Contractor shall take every precaution necessary to prevent dirt or debris from entering the main.
- C. The Town is not responsible for the water tightness of its valves on existing facilities. If existing valves leak, the Town shall assist in reducing the influx of water, but the Contractor must use methods at his own disposal to dewater the trench and complete any required testing and disinfection of the water line.
- D. All connections shall be valved to separate new construction from the existing system. Valves shall be kept closed until acceptance of the new system.
- E. The connection is subject to approval by the Town. Under no circumstances shall a nondisinfected main be connected to an existing disinfected main.

3.4 PIPE INSTALLATION

A. Pipe Laying.

1. Lay pipe with the bells pointing in the direction the Work is progressing.
2. Take effective measures to prevent opening of joints during bedding and backfilling operations.
3. Complete the joint in accordance with the applicable pipe material specification and adjust the pipe to the correct line and grade as each length of pipe is placed in the trench.
 - a. Make adjustments in line and grade by scraping away or filling pipe bedding under the entire length of the pipe, except at bells, and not by wedging, blocking, or mounding up the pipe or bells.
4. Secure the pipe in place with the specified bedding tamped under and around the pipe except at the joints.

- a Do not disturb the pipe after the jointing has been completed.
 5. Install the pipeline so that a positive or negative grade is maintained between high and low points.
 6. Provide a minimum depth of cover from finished grade to top of pipe of 4.5 feet (54 inches).
- B. Separation of water, sanitary sewer (Including services and laterals), and storm sewer.
1. Parallel installations: Water mains shall be laid at least 10 feet horizontally from existing and proposed sanitary sewers. The distance shall be measured edge to edge of pipes.
 2. Crossings: Water main and sanitary sewer crossings. Water mains crossing sanitary sewers and sanitary sewers crossing water mains shall be laid to provide a minimum vertical distance of eighteen (18) inches between the outside of the water main and the outside of the sanitary sewer. The crossing shall be constructed such that the water main is above the sanitary sewer.
- C. Special Conditions
1. When it is impossible to obtain proper horizontal and vertical separation as stipulated above, and whenever the water main crosses under a sanitary sewer the crossing sewer pipe shall be constructed of ductile iron or PVC pressure pipe and the pipe shall be a minimum of eighteen (18) feet long. It shall be located such that both ends of the pipe will be as far from the crossing as possible. The sewer shall remain pressure class until the minimum horizontal conditions above are met. The Town may require that both water and sewer be pressure tested to assure water tightness. Special structural support for the water and sewer pipes may be required.
 2. Pressure pipe shall be the same size or larger than the non-pressure pipe. Use watertight transition couplings where sewers cross water mains and the sewer outside diameters are different than the pressure pipe outside diameters. The pressure pipe shall be larger than the non-pressure where the outside diameters are different. Transition couplings must be acceptable to the Town.
 3. The Town may allow concrete encasement in lieu of the above at the option of the Town.

- a All joints of the sewer which are located within 10 feet on both sides of the water line shall be encased in reinforced concrete. Encasement must be acceptable to the Town.
- b Provide suitable backfill or other structural protection to prevent settlement or failure of the higher pipe.

3.5 THRUST RESTRAINT

- A. Concrete thrust blocks shall be designed for the internal pipe pressure, surge pressure and the soil bearing capacity. The concrete shall have a minimum 28 day compressive strength of 3000 p.s.i. Forms for thrust blocks may be required.
 - 1. Provide concrete thrust blocks for preventing pipe movement at hydrants, crosses, tees, and bends installed in piping and called for on the Drawings.
 - a Tie concrete blocks to fittings, by 2 "U" shaped No. 4 rebar.
 - b Bend ends of rebar 90 degrees out, length 3 inches.
 - c Rebar embedment: one-half pipe O.D. - plus 6 inches.
- B. Extend concrete to solid undisturbed earth. Construct so joints and drain holes are clear and accessible.
- C. For size of thrust blocks see drawing exhibits.
- D. Concrete to be separated from fittings and hydrants by 8 mil polyethylene film. No concrete shall be poured directly on or over fittings to be blocked.
- E. Excavate thrust block bearing into undisturbed soil.
- F. Clean out loose soil and carefully shape to provide uniform bearing surfaces of the proper area.
- G. Notify Town 24 hours prior to concrete placement.
- H. Install thrust blocks so bottom is flat and sides are vertical.
- I. Form to provide access to fittings, and hydrants.

3.6 Joint Restraints

- A. Joint restraints and restrained joint pipe required in all areas by the Town.
- B. All fittings including bends, tees, crosses, and valves require joint restraints.

C. Joint restraints shall be in addition to appropriately sized thrust blocks.

3.7 INSTALLATION OF PIPELINE APPURTENANCES

A. Install valves, hydrants and other equipment appurtenant to the water lines at the locations shown on the Drawings or as designated by Town to accommodate field conditions.

1. Record measurements of the actual location of appurtenant equipment prior to backfill and record for the Record Drawings.

B. Plug and restrain plug to pipeline in dead end water lines.

1. Close valves on all dead-end water lines after testing and Substantial Completion of the water line.

2. Use mechanical joint pipe and plug.

3.8 PROTECTION OF METAL SURFACES

A. Protect supplied material by one of the following methods including coatings that have been damaged:

1. Polyethylene encasement, reference Section 02615.

2. Apply two coats of coal tar paint to ferrous metal rods, rebars, clamps, bolts, nuts and other accessories which are subject to submergence or contact with earth or fill material, and are not encased in concrete.

a Apply first coat of coal tar paint to a dry, clean surface.

b Allow first coat of coal tar paint to dry before the second coat is applied.

3. Protect ferrous metal rods, rebars, clamps, bolts, nuts and other accessories which are subject to submergence or contact with earth or fill material, and not encased in concrete with one coat of coal tar paint and double wrap with Protecto Wrap.

3.9 DISSIMILAR MATERIALS

A. Whenever it is necessary to join materials of dissimilar metals, an approved insulated joint shall be installed. The Contractor shall conduct a resistivity test across the joint. If the resistance test fails, the insulated joint shall be removed and repaired. The joint shall then be reinstalled and retested. This procedure shall continue until a successful test result is obtained.

* * * END OF SECTION * * *

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SECTION 02714
PIPE BURSTING FOR PRESSURE WATERLINES

PART 1 GENERAL

1.1 DESCRIPTION

A. This section addresses the procedures to be employed for rehabilitation or replacing existing pressure water pipelines by pipe bursting as identified on the Drawings, and replacing with new pipe.

1.2 RELATED WORK

A. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Sections in Division 1 of these Specifications.

1. Section 01000 – General Conditions
2. Section 02622 – Fusible Polyvinyl Chloride Pipe
3. Section 02713 – Water Distribution and Transmission System

1.3 STANDARDS

A. References to Standard Specifications shall be understood to mean the latest revision of said specification as amended prior to the date of solicitation of bids, except as otherwise noted in the Contract Documents.

1.4 SUBMITTALS

A. The Contractor shall provide certifications, shop drawings and samples for all materials specified for use on the project as specified in Section 01330 - Submittals.

1.5 EXPERIENCE

A. The Contractor shall have prior experience with this type of installation, demonstrate proof of instruction by the Licensor, or provide on-site services of the Licensor until such time the Contractor's competency to perform the work is satisfactory to the Owner and/or Engineer.

PART 2 PRODUCTS

2.1 PIPE

- A. Pipe shall be diameter called out on the Drawings DR-18 fuse jointed polyvinyl chloride (FPVC). Refer to specification Section 02600 – Fusible polyvinyl chloride pipe for pipe material handling and testing.

2.2 TRACER WIRE FOR BURST PIPE INSTALLATIONS ONLY

- A. Tracer wire shall be a minimum #12 CCS, extra high strength hard drawn 1150# steel core copper wire as manufacturer by Copperhead specifically for the directional drilling industry. The wire outer jacket color shall be blue.
- B. When splices are required, a wire connector equal to 3M DBR-6 shall be used. Splices shall be wrapped water-tight with one layer of filler tape followed by a second layer of "Scotchwrap".

PART 3 EXECUTION

3.1 SAFETY

- A. The Contractor shall carry out operations in strict accordance with all applicable OSHA Standards. Particular attention is drawn to those safety requirements involving work entry into confined spaces. It shall be the Contractor's responsibility to familiarize and its employees with OSHA Standards and regulations pertaining to all aspects of the work.

3.2 INSERTION AND RECEIVING EXCAVATIONS

- A. Before excavation is begun, it will be the responsibility of the Contractor to check with the various utility companies and determine the location of existing utilities in the vicinity of the work area. The Contractor at no cost to the Town, if required, will arrange temporary construction easement and/or right-of-way areas.
- B. Damage to utilities and the resulting repair, temporary service cost, etc., shall be borne by the Contractor. Access pits shall be backfilled in accordance with the appropriate Specifications.
- C. All excavations shall be properly sheeted/shored in accordance with relevant Specifications for trench safety systems. Any damage resulting from improperly shored excavations shall be corrected to the satisfaction of the Engineer or Town with no compensation due to the Contractor.
- D. All open excavations shall be kept secure at all times by the use of barricades with appropriate lights and signs, construction tape, covering with steel plates, etc., or as directed by the Engineer, Town or appropriate Authority.

- E. One or more receiving pits shall be excavated at the end(s) of the pipe to be replaced or at appropriate points within the length of the existing pipe. Pit shall be centered over the existing pipe.

3.3 MATERIALS HANDLING

- A. No materials shall be dumped, dropped, pushed or rolled into a trench. Pipe may be pulled longitudinally into the trench after fusion of the pipeline. Pulling of the main shall be accomplished by mechanical action during pipe bursting

3.4 LAUNCHING AND BURSTING PIT

- A. Pits shall be located along the alignment of the pipe as shown on the Drawings. Deviations from the proposed locations shall be approved by the Engineer or Town in advance of any excavation.

3.5 SERVICE PITS

- A. Pits shall be required to install service connection fittings and reconnect services to the newly installed pipe.

3.6 SERVICE LINE REPLACEMENT

- A. The Contractor shall provide and maintain a schedule for replacing service lines and method for replacing lines (directly connecting or directional drilling of new service lines).

3.7 PIT CONTAMINATION PREVENTION

- A. Pits shall be kept as dry as possible and shall be excavated to at least one (1) foot below the pipe invert to minimize the potential for contamination during connection of the new main valves, fittings, and services.

3.8 PIPE JOINTING

- A. Sections of PVC replacement pipe shall be assembled and joined on the job site above the ground. Jointing shall be accomplished by the heating and butt-fusion method in strict conformance with the manufacturer's printed instructions. The butt-fusion method for pipe jointing shall be carried out in the field by certified operators with prior experience in fusing PVC pipe with similar equipment using proper jigs and tools per standard procedures outlined by the pipe manufacturer. These joints shall have a smooth, uniform double rolled back bead made while applying the proper melt, pressure, and alignment. It shall be the sole responsibility of the Contractor to provide an acceptable butt-fusion joint. The Contractor shall make all joints available for

inspection before the insertion. The replacement pipe shall be joined on the site in appropriate working lengths near the insertion pit.

*** END OF SECTION***

SECTION 02715 – DIRECTIONAL DRILLING

PART 1 GENERAL

DESCRIPTION

- A. Horizontal directional drilling (HDD) construction for the installation of DR18 fuse jointed polyvinyl chloride (FPVC) pipe for use as water main.
- B. Excavate and backfill access pits. Excavation includes earthwork, topsoil stripping, excavating, rock excavation, obstruction removal, filling and grading to obtain required finish contours and elevations.
- C. This specification section includes the HDD construction, installation of the water mains in the HDD construction pathway, securing the ends of the water mains at the end of the HDD installed section to prevent contamination from entering the pipes, disposal of all drill fluids and spoils from the HDD construction, and rough grading of the construction work zones.

RELATED WORK

- D. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Sections in Division 1 of these Specifications.
 - 1. Section 01000 – General Requirements
 - 2. Section 02622 – Fusible Polyvinyl chloride Pipe
 - 3. Section 02713– Water Distribution and Transmission Systems
 - 4. Section 01656 – Disinfection of Domestic Waterlines

QUALITY ASSURANCE

- E. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

- F. Key Staff as defined in Section 1.04 Paragraph D.3, shall not be changed or replaced from those identified by the Contractor in the required submittal without written permission by the Engineer or Town.
- G. Coordinate the work of this Section with the work of other related Sections.
- H. Prepare to utilize a mud/slurry drilling method for completion of the HDD to satisfy the requirements of the Work.
- I. Prior to beginning any HDD work, the Contractor shall lay out and stake the ends of the proposed drill path including starting and ending point locations using the coordinates and other details provided on the Drawings. The Contractor shall identify and submit in writing a request for any variances from the HDD alignment from the Drawings along with a basis for the request for consideration by the Engineer at least two weeks prior to the starting of drilling. This request does not include changes in the drill path by the Contractor during construction as new data becomes available. If there is no request for variances then the Contractor shall submit a letter to the Engineer stating that the site layout is acceptable for the Contractor's means and methods prior to starting the Work.

SUBMITTALS

- J. Comply with pertinent provisions of Section 01000 – General Requirements.
- K. General Company Profile: The general company profile shall provide: a summary of the company's present size in terms of gross annual revenue; number of projects completed per year for the last five (5) years; years of operation; number of full-time employees and engineering staff; a list of similar size projects municipal water main projects, two of which must have been at least 650 feet in length, that have been completed within the past five years including project name, contract amount, length, pipe diameter, and soil conditions for the drill; and three project references with project descriptions, value of contract, and current name and phone number for a reference. The general company profile shall demonstrate that the company or a company principal has a minimum of five (5) years continuous experience in horizontal directional drilling; owns the equipment necessary to do this project; has a minimum of two (2) full time drillers, one (1) of whom must meet the requirements of Paragraph 1.04 – D.3; and has the financial resources and meets the insurance requirements for this project.
- L. Engineer and Town reserve the right to disqualify directional driller not satisfying the intent of these requirements.
- M. Within thirty five (35) days after Contractor has received the Town's Notice to Proceed submit:

1. Task Schedule outlining key procedural steps and schedule to be used in performance of the Work.
 2. Work Plan describing in detail the proposed equipment and key procedural steps, including, but not limited to:
 3. Entry and Exit work pad configurations for each drill including size, capacity, arrangement of equipment, storage of fuel, pipe, expendables, drill fluid containment locations and details, assembled pipe storage, and location and size of entry and exit pits.
 4. Dewatering method.
 5. Tracer Wire: Method of securing the tracer detection wire to PVC pipe for installation with the pipe and end termination detail.
 6. Product Pipe Assembly: Method of butt fusing pipe segments, type of equipment to be used for butt fusing, surface handling of the pipe to prevent damage during assembly and installation such as rollers and installation over bend requirements, and training/experience certificates for field personnel who will be involved in pipe butt fusing operations.
 7. Initial Drill Fluid Design: bentonite clay and all anticipated additives, including product information, material specifications, handling procedures, Material Safety Data Sheet (MSDS), special precautions.
 8. Certificates of Compliance for fusible PVC pipe.
- N. Key Staff Resumes: Provide resumes of key staff that will be assigned to this project. Engineer must approve any variance from this requirement and reserves the right to delay commencement of the HDD operation until adequate supervisory staff is on site. Key staff shall demonstrate on their resumes that they meet the following qualifications:
1. Driller: Minimum five (5) years experience as a horizontal directional driller and have completed at least two (2) projects of similar length and conditions.
 2. Superintendent: Minimum three (3) years experience with the bidding company as a superintendent and have a minimum of one (1) similar project experience.
 3. Tracking specialist: Minimum three (3) years experience with tracking system to be employed.
 4. Drill Fluid Specialist: Minimum three (3) years experience... This person shall have the authority to design, change, or approve drill

fluid chemistry for the Contractor activities for this project. This person shall be on-site during all drilling operations involving drill fluids.

- O. Instrumentation System for drill and drill fluid monitoring. Include the manufacturer of the system and designated person responsible for installing and maintaining an operational system that will be on-site full time during drilling operations. The Instrumentation System shall include as a minimum instruments for monitoring the following:
1. Drill rig thrust and torque calibrated for the specific drill, pump pressure and volume for drill fluids,
 2. Drill head and carriage position in the hole.
 3. Contractor's estimate of pull forces for each pipe segment to be installed.
 4. Tracking System Submittal including data on the proposed guidance system, and the accuracy of the guidance system at the design drill depths. The system shall be capable of providing horizontal and vertical steering data along the entire drill path for each crossing, for the depths shown on the Drawings, plus an additional ten (10) feet.
 5. Fuel and Hydraulic Fluid Containment and Contingency Spill Plan. Include means and methods for managing, containing, and cleanup of fuel and oil spills should they occur at the site. Contractor shall dispose of all fuel, oil, or other leakage from equipment including diapers, absorbent material, and other related cleanup and spill control materials. At a minimum a fuel and oil spill kit shall be located at each end of the drill paths for the duration of directional drilling and pipe installation.
 6. Drill Fluid Management and Contingency Release Plan describing means and methods for containment, collecting and disposal of drill fluid during the project, equipment and materials included in a site specific Drill Fluid Spill Kit, and procedures to be followed to minimize damage due to frack-outs. A Drill Fluid Spill Kit shall be located in the middle of each drill paths and during all drilling operations and shall include as a minimum: operational pumps and power supplies adequate for operating the pumps at any location on the site or along the drill paths, straw/hay bales for containment, shovels, brooms, and rakes for cleanup. Plan shall fully describe procedures to be used to remove inadvertent drill fluid releases and procedure for shutdown of drilling operations once a release has been detected at the surface and procedure for restarting the drilling operations once the release has been contained and both mitigation measures and future release containment at the release location have been established.

- P. Record HDD Drawing. Upon completion of the work, the Contractor shall submit the following information to the Engineer comprising the Record Drawing:
1. Record plan and profile information for each drill path based on electronic guidance system data. At a minimum, a survey data point shall be obtained for the record drill path for each drill rod. Alternatively, the driller may survey the inside of the pipes following installation for record location and elevation.
 2. Pressure test results for the pipes.
- Q. Cuttings, Bentonite Slurry, and Pit Spoil Disposal Submittal: Provide within 30 days of completion of the drills a list of volumes of all cuttings, bentonite slurry, and pit spoil disposed of off-site and the location of the disposal area.
- R. Daily Reports: By the close of business following each work day, Contractor shall submit a daily report. As a minimum, the report shall contain the following information:
1. Drill fluid daily required data.
 2. Daily activities, including summary of progress for the drilling operations.
 3. Status of drilling operations with respect to key items in the project schedule and mitigation measure if behind schedule.
 4. Problems that occurred during the day and resolution of problem or required action item.
 5. List of equipment and personnel at the site.

STANDARDS

- S. The following American Water Works Association (AWWA) standards form a part of this specification as referenced:

AWWA C906	Polyethylene Pressure Pipe and Fittings, 4 In. Through 63 In. for Water Distribution and
AWWA C605-13	Underground Installation of Polyvinyl Chloride (PVC) and Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe and Fittings

- T. The following American Society for Testing and Materials (ASTM) standards form a part of this specification as referenced:

ASTM D1784	Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds
ASTM D2837	Standard Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials or Pressure Design Basis for Thermoplastic Pipe Products
ASTM F477	Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe

SPECIAL REQUIREMENTS

- U. Permits applications have been submitted to Federal, State and Local agencies for this work. Copies of these permits and the permit conditions are contained in the Contract Documents and should be reviewed prior to bidding. The Contractor shall be responsible for full compliance with various permit conditions. Failure to comply with permit conditions will result in the Town shutting down the drilling operations until compliance is established and confirmed. Compliance with permit conditions shall be established and verified at no additional cost to the Town.
- V. The Horizontal Directional Drill (HDD) alignments shall be oriented as shown on the Drawings.
 1. Minimum depth of the HDD alignments shall be as shown on the Drawings.
 2. Installation tolerance shall be a two (2) foot radius circle around the design drill path centerlines, as shown on the Project Plans.
 3. The exit point tolerance shall be right/left two (2) feet
 4. The tracking system shall be capable of providing horizontal and vertical steering data along the entire drill path for each crossing, for the depths shown on the Project Plans, plus an additional 10-ft.
 5. Contractor shall provide two way radios to allow communication between crews. Radios shall be complete with built-in antennas, squelch and volume controls, and rechargeable battery packs. The Contractor shall not commence work until there is a working radio at each entry and exit location of an active drilling operation.

6. Contractor shall be responsible for containing and collecting all drilling fluid released inadvertently, and other remediation tasks which may be required by the Engineer or permit agencies. Such work shall be at no additional cost to the Town.
7. Contractor shall implement the Drill Fluid Management and Contingency Release Plan.
8. Contractor shall implement the Fuel and Hydraulic Fluid Containment and Contingency Spill Plan.
9. Contractor shall stop all drilling operations and shall notify Engineer at the earliest opportunity and no longer than one (1) hour after first observation of a drill fluid release at the ground surface or into a waterway (outside of the designated Entry and Exit work zones).
10. Contractor shall obtain and pay for construction-related permits for project water and road use and pay for all water consumed by the construction process. Contractor shall contact Colorado One Call at (800)-922-1987 a minimum of seventy two (72) hours prior to any excavation or drilling and obtain utility clearance for all construction work. This utility clearance permit shall remain active for the duration of the project.

PART 2 PRODUCTS

GENERAL

A. Fused Polyvinyl Chloride (FPVC) Pipe

1. Pipe shall consist of DR18 fuse jointed polyvinyl chloride (FPVC) pipes for use as water mains.
2. Refer to Specification Section 02600 – Fusible polyvinyl chloride pipe for pipe material, handling, and testing requirements.

B. HDD Machine

1. The Contractor is responsible for the final determination of the drill rig size.
2. Shall have sufficient capacity to complete the proposed drilling operations, and pipe pullback.
3. Shall have a system to monitor and record maximum pullback pressures during the pullback operation.

4. Shall have a drill head that is steerable by changing its rotation and shall provide the necessary cutting surfaces and drilling fluid jets suitable for the conditions indicated in the Contract Documents.
5. Shall have an anchorage system to anchor drilling machine to the ground to resist thrust and pull forces during operation.

Drilling Fluids (Mud/Slurry) System

- C. Drill fluid shall be designed for this specific project conditions by the Drill Fluid Specialist. All components of the drill fluid shall be NSF 61 certified. Typical acceptable drill fluids consist of bentonite clay (compatible with the environment) and clean water. It shall be the responsibility of the Contractor to select appropriate drill fluid cleaning equipment for the drill production rate and for the anticipated site soil and groundwater conditions. The Drill Fluid Specialist is responsible for assessing project water supply and project conditions and for the design and implementation of drill fluid and water treatments for project specific conditions. The Drill Fluid Specialist and Contractor shall be responsible for providing a drill fluid circulation and recycling system that is compatible with the drill production rate.
- D. Waste oil, diesel fuel, or environmentally non-compatible polymers cannot be part of the drilling mud/slurry composition.
- E. Engineer shall be informed of all additives. All additives shall be compatible with the environment.

Drill Fluid Parameters.

- F. Drilling fluid parameters (density, viscosity and sand content) shall be measured and recorded every two hours, or after a noticeable change in fluid returns. This information shall be attached to the daily drilling report provided by the Contractor to the Engineer. Drill fluid properties shall be determined by the Drill Fluid Specialist for this project. The following provides required measurements and provides the properties assumed for the design of the drill path depth. Fluid density shall be measured using a balance beam scale made for fluid density measurements. All components of the scale shall be cleaned and calibrated at the beginning of each shift and cleaned before and after each measurement is taken. If any damage is suspected to any part of the scale, the scale must be repaired and calibrated according to the manufacturer's specifications. Damaged components must be replaced immediately.
- G. Viscosity shall be measured and recorded with a Marsh Funnel. The viscosity will be determined by the Drill Fluid Specialist.

- H. Sand content shall be measured and recorded with a sand content measurement kit. Sand content should be kept below 1% to avoid excessive increases in fluid density as well as wear and damage to equipment.
- I. Drill fluid system shall have filters in-line to prevent solids from being pumped into the drill pipe.
- J. Drill fluid system shall have connections between the pump and drill pipe that are relatively leak-free.
- K. Any spilled drilling fluid shall be fully contained in a 12-inch (minimum) height berm erected and maintained around the HDD machine, along connections between the mud cleaning system, and around the mud cleaning system, and properly disposed of.

Mixing System

- L. A self-contained, closed drilling fluid mixing system shall be of sufficient size to mix and deliver drilling fluid composed of bentonite clay, water, and approved additives.
- M. Mixing system shall be able to molecularly shear individual bentonite particles from the dry powder to avoid clumping and ensure adequate mixing.
- N. Drilling fluid reservoir tank shall be of adequate size for the Work.
- O. Mixing system shall continually agitate the drilling fluid during drilling operations.

Mud/Slurry Motors

- P. Shall be of adequate power to operate the required drilling devices, if used.

Guidance System

- Q. Shall be a tracking system capable of locating the drill within a two (2) foot radius inscribed around the drill path and shall be set up and operated by field personnel trained and experienced with the system.

Pipe Rollers

- R. Pipe rollers shall be of sufficient size to fully support the weight of the pipe while being butt-fused, pressure-tested, and/or during pullback operations.
- S. Tracer wire shall be a minimum #12 CCS, extra high strength hard drawn 1150# steel core copper wire as manufacturer by Copperhead specifically

for the directional drilling industry. The wire outer jacket color shall be blue.

PART 3 EXECUTION

GENERAL

- A. The drill path designs are included on the Project Drawings. The Contractor is fully responsible for implementing a safe and effective drilling plan.
- B. Notifications: Provide notification to the Engineer a minimum of seventy two (72) hours before mobilizing onto the site. Provide notification forty eight (48) hours in advance of casing installation and drilling. Provide notification forty eight (48) hours in advance of pressure and acceptance verification tests on the PVC pipe.
- C. Construct the perimeter bentonite slurry, cuttings, and pit spoil control system, and storm water control barrier in accordance with Best Management Practices in the local area. The system shall provide positive containment for all drilling fluids and drainage from drill cuttings and prevent any of the drill fluid or drainage fluids or other drill fluid contaminated material or fluid from leaving the open pit areas
- D. Establish a secure and contained construction work area at the drill rig. Excavate and verify all utilities identified or marked out in the field that may conflict with the Work. Expose all utilities within fifteen (15) feet of the drill path and leave exposed until after completion of the pilot drill or until the protective steel casing has been installed past the utility location. Use an air-vacuum system to expose the utilities.
- E. Maintain the work site in a clean and safe manner.
- F. Set entry and exit area steel conductor casings as indicated.
- G. Excavation, backfill and compaction of access and test pits shall be in accordance with Section 02221. When water is encountered, provide and maintain a dewatering system of sufficient capacity to remove water. Keep all excavations and access pits free of water until backfill operation is in progress. Perform dewatering in such a manner that removal of soil particles are held to a minimum.
- H. Excavate and maintain drill fluid pressure relief holes as necessary. Maintain at least one vacuum excavation truck on-site at all times during HDD operations, to contain and transport drill fluid from pressure relief holes to established containment and treatment areas. Contractor will be

responsible for pressure relief hole excavation, protection of pedestrian and vehicular traffic, excavation support and safety, and excavation backfill.

- I. Spill and bentonite slurry management shall be in accordance with requirements stated in the project permits, and in the approved Drill Fluid Management and Contingency Release Plan, which shall include the following measures:
 1. Controls in place to stop drilling activity, assess the drill path for observable releases, and control any observable release in a timely manner. Notify the Engineer of circulation losses greater than 25% of downhole pump volumes and for all observable bentonite slurry releases at the earliest opportunity, confirm in by the end of the work shift, and include in the Daily Report.
 2. Be prepared to contain a potential observable blowout or bentonite slurry release. On observing a slurry release, stop all drilling operations, contain the release, and clean up the release. Cleanup, disposal, and environmental restoration that may be required as a result of an observable release is the responsibility and cost of the Contractor.
- J. Directional drilled pipe (FPVC) shall be installed to depths as required to permit the pipe to be laid at least at the minimum elevations indicated in the specifications and at the approximate locations shown on the Drawings. Directional drilled pipe shall be installed in one continuous pipe segment as shown on the Drawings. The top of the drilled pipe shall be installed a minimum of five (5) feet below pavement or as shown on the Drawings.
- K. The Contractor shall use electronic survey instrumentation to monitor and adjust the drill head. The survey system shall measure the horizontal and vertical location of the drill head throughout the bore and provide sufficient readings to allow for slope adjustment. If magnetic interference affects the bearing sensors of the steering tool, the Contractor shall use appropriate methods to maintain the required slope and alignment within project tolerances. Obtain an accuracy range of within two percent (2%) of the depth of actual position of the steering device.
- L. In each case, a pilot hole shall be drilled along the path, as shown on the Drawings. Do not exceed allowable bending radius of PVC pipe. Pilot hole shall have the following tolerances:
 1. Vertical alignment plus or minus two (2) feet. Vertical path of the pilot hole must not establish new high points not shown on the Drawings.
 2. Horizontal alignment plus or minus two (2) feet.

- M. A Draft Record HDD Drawing of the finished pilot hole shall be furnished by the Contractor for approval by Engineer prior to pull-back of the pipe to be installed. Provide Engineer with tabulations of horizontal and vertical alignment.
- N. Notify the Engineer immediately when forward motion of operation is stopped by an obstruction. Attempt a second installation using mud/slurry drilling method only if approved by Engineer.
- O. The pilot hole shall be reamed to a diameter to be determined by the Contractor that is sufficiently sized in order to reduce forces applied to the pipe during pull back.
- P. A swivel shall be installed between the reamer and the pipe connection to minimize torsional stress imposed on the pipe and allow the reamer to turn without rotating the pipe.
- Q. If required by the Engineer, fill the PVC pipe with water during the pulling installation process, and pull the pipe to the end of the drill. The water fill level should not exceed the ground elevation at the point that the pipe enters the ground. The pipe on the rollers or ground should remain free of ballast water.
- R. Measure and record the force required to pull the pipe into the hole during the installation. Record the drill string length (number of rods), and pulling assembly and drill rod size. Record the average and maximum force for each drill rod pulled from the drill rig pressure gages and provide calibration factors to convert pressure to force for each gear. Prior to pulling the pipe, pull the drill string with lead reamer and swivel and measure the amount of force required by the drill rig to move the assembly and provide a measurement of the amount of force required to move the drill carriage using the same gears as used for the pulling operation. Provide this information in the Daily Report.
- S. All pipe pulled through the pilot holes shall have one (1) continuous tracer wires securely fixed to the pipe.
- T. Because of the elastic properties of the PVC pipe, main line and service connection pipe shall be relaxed for at least one overnight period in order to return to its original pre-pull length prior to making any connections. The pipe shall be installed past the exit tie-in point, a minimum of ten (10) feet, to accommodate thermal contraction as well as viscoelastic stretch recovery in the pipe.
- U. The leading edge of the pipe shall be examined for significant external damage after pull back. If the pipe is deemed by the Engineer to have

suffered significant damage, the damaged pipe shall be cut off and additional pipe pulled through the hole prior to the relaxation period.

- V. The Contractor shall be responsible for the containment and disposal of all drilling fluids or bentonite mud/slurry. The Contractor shall stockpile haybales at the drilling site to contain an inadvertent bentonite mud/slurry return. Any haybales or drill fluid containment devices used for containment of mud/slurry shall be removed from the site and properly disposed of at the completion of the Work.
- W. The pullback shall be conducted in on continuous operation to limit the potential for binding of the pipe in the hole.
- X. Sections of the PVC shall be connected in accordance with the manufacturer's recommendations.
- Y. The Contractor shall provide all the appurtenances and make the pipe connections as required to ensure a complete working system. MJ adaptors shall be butt fused to the PVC pipe.
- Z. Complete surface connections as indicated in the Contract Documents.
- AA. The access pits shall be kept to a minimum.
- BB. Settlement or displacement of surface and adjacent facilities shall be monitored closely. Notify Engineer immediately if settlement or displacement is detected. Act to maintain safe conditions and prevent damage.
- CC. Should the Contractor abandon a hole for their convenience before the holes is completed, then the Contractor shall seal the drill hole with bentonitic environmental grout or cementitious grout and re-drill at no additional cost.

PIPE TESTING AND DISINFECTION

- DD. The PVC pipe shall be disinfected and pressure tested in accordance with Sections 01656 and 01666. The directional drilled pipe will not be accepted until final connections are made, pressure testing, chlorination and BacT test are completed and approved.

FINAL INSPECTION FOR ACCEPTANCE OF HDD

- EE. Final inspection of the Work shall include a visual inspection, if possible, of each section of pipe by looking from the access pipe with the aid of reflected sunlight or illumination equipment. The pipe shall be true to both line and grade, shall show no leaks, shall be free of cracks and from

protruding joint materials and contain no deposits of sand, dirt or other material which will reduce the full cross-sectional area. Structural wall joints shall be tight. All finished work shall be neat in appearance and of high quality work. The Contractor shall furnish laborers and illumination equipment to assist the Engineer in this inspection.

END OF SECTION

**DIVISION 3 –
SANITARY SEWER**

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SECTION 01015

APPROVED PRODUCT LISTING – SANITARY SEWER

PART 1 GENERAL

1.1 DESCRIPTION:

- A. This section lists the required manufacturers and/or products referred to in the related sections of the standard construction specification.

PART 2 SECTION 02730 WASTEWATER COLLECTION SYSTEMS

A. PIPE MATERIALS

1. PVC, reference Section 02622

B. MANHOLE MATERIALS

1. Cast-In-Place Bases
 - a Reference section 02520
2. Pipe penetration gaskets
 - a Kor-N-Seal, Dukor Company
 - b PS-10, Press Seal Gasket Corp
 - c A-Lok, A-Lok Corp
 - d Lock Joint Flexible Manhole Sleeve, Interpace Corp
 - e Or Town approved equal
3. Barrels, Cones, and Grade Rings
 - a Material: Precast Concrete, ASTM C478
 - b Cement: Type II
4. Ring and Cover
 - a Neenah R-1706, w/smooth cover pattern
 - b Or Town approved equal

5. Polypropylene Steps: ASTM C478
 - a M.A. Industries (PS-2-PFS)
 - b Or Town approved equal

6. Pre-formed Plastic Gaskets.
 - a "Rub'r-Nek: K.T. Snyder Co
 - b "Kent Seal", Hamilton-Kent Manufacturing Co
 - c GS #79, 44, or 4, General Sealants
 - d ConSeal, CS202
 - e Or Town approved equal
 - f "Ram-Nek" is not acceptable

END OF SECTION

SECTION 01020
WASTEWATER COLLECTION DESIGN CRITERIA

PART 1 MINIMUM DESIGN CRITERIA

1.1 GENERAL

- A.** All wastewater collection systems will comply with the requirements of the Standards and Specifications for wastewater construction and may include criteria established by the Town for the overall hydraulics of the wastewater utility system. Other criteria may be outlined as determined by the Town on a project by project basis.

1.2 QUANTITY OF WASTEWATER

- A.** Residential wastewater flows will be determined by using an average daily flow of 100 gallons per person per day and averaging 2.7 persons per dwelling unit. Industrial and commercial area flows will be determined using 2280 gallons per acre day, unless actual data is given that exceeds the above figures.

- B.** Design shall be based upon peak daily flows found by using peaking factors (P.F.) as determined by the Town. In general, for domestic wastewater flow:

$$P.F. = \frac{5}{p^{0.167}}$$

Where:

$$p = 1000\text{'s of people}$$

These factors may differ throughout the Town. Design flow shall be the sum of the peak flow and the flow due to infiltration and inflow (I/I), to be estimated as:

$$I/I = 500 \text{ gpd / acre}$$

- C.** In all cases sanitary sewer lines shall be designed to carry as a minimum the following flows when running half (½) full.

Laterals & Sub mains	400 gallons per day per person
Mains, Trunk lines & Interceptors	250 gallons per day per person.

- D.** Final design to include calculations based upon projected or actual usage, whichever is higher.

- E. UNDERDRAINS: Underdrains are not a part of the sanitary sewer system and they shall not connect to the system at any time.

1.3 DESIGN VELOCITIES AND GRADES

- A. All sanitary sewer mains shall be designed to insure that the average day flow velocities within the pipe will be two (2) feet per second as a minimum and ten (10) feet per second as a maximum. Sanitary sewer mains (8-inch diameter) shall meet a minimum grade of one half (0.5%) percent and a maximum allowable grade of five (5.0%) percent. Grades outside of this range shall require specific approval by the Town Engineer.

1.4 MAIN SIZES

- A. Sanitary sewer mains constructed under these Standards and Specifications shall be designed so as to adequately serve the entire area when fully developed. The minimum allowable size for a main is eight (8) inch diameter. The Town reserves the right to resize any sewer main that it deems inadequate for the proposed use, based on standard engineering practices.

1.5 SERVICE LINES

- A. Each structure and each subdivided lot shall be served by a separate service line. No compound services are allowed.
- B. Service lines shall be designed with a minimum fall of one quarter (1/4) inch per foot and a maximum velocity of ten (10) feet per second. The minimum allowable service line size is four (4) inches. Any building requiring larger than a four inch service shall be sized by the Design Engineer based on standard engineering practices. All service line sizes will be subject to review and approval of the Town.
- C. During Town inspection of sanitary sewer service, Contractor shall be present on-site with building permit.
- D. See Section 02732 for sanitary service line marking requirements.

1.6 DEPTH

- A. Sanitary sewer mains shall be designed to have a minimum of eight (8) foot cover.

1.7 ALIGNMENT

- A. Sewer mains shall be laid whenever possible on the center line of the street. Sewer lines shall be located a minimum of ten (10') feet horizontally from existing or proposed water mains (edge to edge distance). Where water and

sanitary sewer cross, reference Section 02713 under the water line specifications for requirements of construction.

1.8 FUTURE EXTENSION OF MAINS

- A.** When a sewer line under construction is anticipated to be extended at a future date, the end of the line shall have a manhole and a plugged stub out installed in the direction(s) of extension. Sanitary sewers must be extended to the far edge of the property to be serviced, or to the edge of the platted subdivision. All extension lengths shall be subject to the approval of the Town. When a sewer line is not to be extended at some future date, the line being installed shall extend a minimum of ten (10') feet into the last property to be served and a manhole shall be installed. No services shall be placed on an extension of the upstream side of a manhole.

1.9 MANHOLE SIZE AND SPACING

- A.** Manholes should be located at all changes in grade, pipe sizes, and alignment.
 - 1. For changes in pipe size, the crowns of the pipes shall be at the same elevation, or the drop across the manhole between the incoming and outgoing flow shall be 0.2 feet whichever is greater.
 - 2. Manholes that do not have a change in alignment or pipe size shall have a drop across the manhole between the incoming and outgoing flow of 0.1 feet minimum.
 - 3. When a tee invert is constructed, the invert coming into the straight through channel must be at least two tenths of a foot (0.2') higher than the out invert.
 - 4. No curved sewer pipe may be used.
 - 5. Manholes shall be located at street intersections whenever possible.
 - 6. Manholes that have changes in the pipe alignment of less than forty five (45) degrees shall have a minimum of one tenth (0.1) foot drop through the manhole.
 - 7. Manholes that have changes in pipe alignment of between forty five (45) and ninety (90) degrees shall have a minimum of two tenths (0.2) foot drop through the manhole.
 - 8. No change in pipe alignment greater than ninety (90) degrees is allowed.
- B.** Manholes are to be a minimum of four (4) feet in diameter. Required diameter shall be as shown on DWG. REF 3-4 and 3-6.

- C.** Manholes must be spaced no farther than four hundred (400) feet apart.
- D.** Manholes should be located in areas which are not subject to flooding from surface runoff. No manholes may be located in areas where ponding or storm detention basins are to be used.
 - 1. Covers. If the possibility of surface runoff cannot be avoided a solid manhole cover, having an integral O-ring type gasket, that can be bolted closed, must be used.
 - 2. All manholes located outside dedicated street rights-of-way or within the 100 year flood plain shall be designed and constructed with a watertight, bolted type cover and the manhole ring shall be bolted to the manhole cone.
- E.** Manholes must be located in areas, which allow direct access via all-weather drives by maintenance vehicles.

* * * END OF SECTION * * *

SECTION 02622
PLASTIC NON-PRESSURE PIPE

PART 1 GENERAL

1.1 DESCRIPTION

- A. This section covers plastic non-pressure sanitary sewer pipe and fittings to be furnished complete with all jointing materials.

1.2 PRODUCT DELIVERY

- A. Do not damage the pipe by impact, bending, compression or abrasion during handling and storage.
- B. Store PVC sewer pipe on a flat surface which provides even support for the barrel with bell ends overhanging.
- C. Do not stack pipe higher than 5 feet.
- D. Do not use pipe and fittings stored in direct sunlight for periods in excess of eighteen (18) months.
- E. Use only nylon protected slings or hands to handle pipe. Do not use hooks or bare cable.

PART 2 PRODUCTS

2.1 POLYVINYL CHLORIDE (PVC) PIPE

- A. Pipe and fittings: 4" through 15", ASTM D3034; 18" through 27", ASTM F-679; type PSM, SDR 35.
1. Fittings shall be of the same material and class as the pipe to which it is attached.
 2. Plugs: PVC, size shall be the same as for the pipe. Plugs shall be air tight for testing of the lines.
- B. Joints: ASTM D3212, push-on with an O-ring rubber gasket conforming to ASTM Designation D3034. Solvent cement joints are strictly prohibited.
- C. Pipe lengths: maximum pipe length shall be twenty (20) feet and no shorter than twelve and one half (12 ½) feet, except service tees and closure pieces.

- D. Markings: All sizes of PVC pipe shall have the SDR rating, the A.S.T.M. Specification, nominal diameter, and name or trade mark of the manufacturer imprinted on the outside of the pipe.

PART 3 EXECUTION

3.1 INSPECTION

- A. In addition to any deficiencies covered by ASTM D3034, PVC which has any of the following visual defects will not be accepted.
 1. Straight pipe, measured from the concave side, shall not deviate from straight greater than 1/16 inch per foot of length.
 2. Pipe which is sufficiently out-of-round to prohibit proper jointing.
 3. Improperly formed bell and spigot ends.
 4. Fractured, cracked, chipped, dented, abrasions, or otherwise damaged pipe.
 5. Pipe that has been damaged during shipment or handling. Acceptance of the pipe at point of delivery will not relieve the Contractor of full responsibility for any defects in material of the completed pipeline.
- B. Mark defective pipe and store on site at a separate location away from the Work until after acceptance of the piping system at which time it shall be removed from the site.

3.2 INSTALLATION

- A. Install pipe in accordance with Section 02730, Wastewater Collection System.
- B. Cutting the pipe.
 1. Cut pipe square with saw or pipe cutter designed specifically for the material.
 2. Bevel the end in accordance with the manufacturer's recommendations.
 3. Insert the spigot to the reference mark, according to manufacturer's recommendations.
 4. Do not disturb previously installed joints during jointing operations.

3.3 FIELD QUALITY CONTROL

- A. Pipe Deflection Tests.

1. Test each reach of sewer pipe between manholes for vertical ring deflection after backfill has been completed.
2. Maximum allowable deflection is 5% of the base internal diameter.
3. Uncover all pipe sections exceeding the maximum allowable deflection and replace the bedding and backfill to prevent excessive deflection.
4. Retest any repaired sections.
5. The maximum allowable deflection at the end of the two (2) year correction period shall be 7 ½ % of the base internal diameter. Uncover and repair sections exceeding the maximum allowable deflections.
6. Mandrel outside diameters in inches are as follows:

Pipe Size	Base I.D.	5% Deflection Mandrel	7-1/2% Deflection Mandrel
6	5.742	5.455	5.311
8	7.920	7.524	7.326
12	11.361	10.793	10.509
15	13.898	13.203	12.856
18	16.976	16.127	15.703
21	20.004	19.004	18.504
24	22.480	21.356	20.794
27	25.327	24.061	23.427

B. Leakage tests.

1. Reference Section 02730, Wastewater Collection Systems.

* * * END OF SECTION * * *

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SECTION 02730
WASTEWATER COLLECTION SYSTEMS

PART 1 GENERAL

1.1 DESCRIPTION

- A. This section covers the installation and testing of gravity sanitary lines plus the furnishing and installation of manhole materials, and other appurtenances.

1.2 QUALITY ASSURANCE

- A. Lay pipe and set manhole inverts true to line and grade shown on Drawings. Under no circumstances shall pipe be laid which results in a level invert, reverse sloping invert, or a grade flatter than will accommodate design flows.

1.3 JOB CONDITIONS

- A. Use effective measures to prevent foreign material from entering the pipe.
- B. Do not place debris, tools, clothing, or other materials in the pipe.
- C. Close the open end of any pipe with a plug, or cap, to prevent the entry of foreign material or water into the pipe.
- D. Use effective measures to prevent the uplift or floating of the line and manholes prior to completion of the backfilling operation.

PART 2 PRODUCTS

2.1 PIPE MATERIALS

- A. PVC, reference Section 02622.

2.2 MANHOLE MATERIALS

- A. Cast-In-Place Bases.
 - 1. Reference section 02520.
 - 2. Precast bases may be used with the approval of the Town and shall meet the following requirements.
 - a. Precast base and first barrel section monolithic, conformance ASTM C478, Type II cement.

- b Pipe penetration gaskets.
 - i. Kor-N-Seal, Dukor Company.
 - ii. PS-10, Press Seal Gasket Corp.
 - iii. A-Lok, A-Lok Corp.
 - iv. Lock Joint Flexible Manhole Sleeve, Interpace Corp.
 - v. Or approved equal.

3. Manhole Base Bedding

- a Manhole base bedding shall be well graded crushed stone or gravel, conforming to ASTM-D448, #67 (also CDOT #67) as listed below:

<u>Size</u>	<u>Percent Passing</u>
1"	100
3/4"	90 - 100
3/8"	20 - 55
#4	0 - 10
#8	0 - 5

- b Or well graded 3/4" angular rock.

B. Barrels, Cones, and Grade Rings.

1. Material: Precast Concrete, ASTM C478.
2. Cement: Type II.
3. Top cone section shall be eccentric unless a flat top section is required to allow for adequate interior headroom.

C. Mortar.

1. One part Portland Cement, ASTM C150, Type II.
2. Two parts sand, ASTM C144.
3. ½ part hydrated lime, ASTM C207, Type S.

D. Grout (Non-Shrink, Non-Metallic)

1. Pre-Mixed: Master Builders "Set Grout", Sika "Grout 212".

E. Ring and Cover.

1. Grey iron: ASTM A48, with asphalt varnish coat applied at foundry.
2. Pattern: The work "sewer" shall be cast in cover. Manhole lid shall be a smooth cover as approved by the Town.
3. Bearing Surfaces: Machined, required for pavement and pedestrian locations.
4. Denver heavy duty traffic lid, 400 pounds combined weight, 24 inch minimum clear opening.
5. Manufacturers
 - a Neenah R-1706, w/smooth cover pattern.
 - b Or approved equal.
6. Manhole frame shall have a reinforced (fiber mesh and #3 rebar) concrete collar around the ring. Collar shall extend 12" beyond the outer edge of ring all the way around ring.

F. Polypropylene Steps: ASTM C478.

1. M.A. Industries (PS-2-PFS).
2. Or approved equal.

G. Pre-formed Plastic Gaskets.

1. Conformance: Fed Spec. SS-S-00210 (GSA-FSS), Type I, Rope Form, primer required on both surfaces of manhole joints.
2. Diameter: 1 ½ inch for 48 inch manhole.
2 inch for 60 inch manholes and larger.
3. Two gaskets are required per joint for vacuum testing.
4. Acceptable Manufacturers.
 - a "Rub'r-Nek: K.T. Snyder Co.
 - b "Kent Seal", Hamilton-Kent Manufacturing Co.
 - c GS #79, 44, or 4, General Sealants.
 - d ConSeal, CS202.
 - e Or approved equal.

- f "Ram-Nek" is not acceptable.

PART 3 EXECUTION

3.1 CONNECTION TO THE EXISTING SYSTEM

- A. The physical connection to the existing sewer system shall be plugged until the sewer has been completed to the satisfaction of the Town. If improper construction methods or materials are used, or excess infiltration occurs, the Town may require the sewer be plugged until satisfactory corrections are made. Two (2) working days notice must be given prior to any connection to the existing system. All materials used for connection shall conform to materials specified for new construction.

3.2 PIPE INSTALLATION

- A. All trenching shall be in accordance with Section 02221 under the water line specifications.
- B. Pipe Laying.
 - 1. Begin pipe laying at the lowest point, unless otherwise approved by Town, and install the pipe with the spigot ends pointing in the direction of flow.
 - 2. Lay pipe true to line and grade. Use of Laser equipment is required.
 - 3. As each length of pipe is placed in the trench, complete the joint in accordance with the applicable pipe material specification and adjust the pipe to the correct line and grade. Make adjustments by scraping away or filling pipe bedding under the body of the pipe, and not by wedging or blocking up the bells.
 - 4. Secure the pipe in place with the specified bedding tamped under and around the pipe except at the joints. Do not use mechanical compacting equipment in the zone above the horizontal centerline of the pipe and below a plane one (1) foot above the top of the pipe. Do not walk on small diameter pipe or otherwise disturb pipe after the jointing has been completed.
- C. For water and sewer pipe crossings see the requirements set forth in Section 02713 under the water line specifications.

3.3 MANHOLE CONSTRUCTION

- A. Constructed cast-in-place concrete base.

1. Invert channels shall be smooth and semi-circular in shape conforming to the inside of the adjacent sewer pipe section.
2. Form inverts directly in the concrete of the base.
3. Changes in direction of flow shall be made with a smooth curve having as large a radius as the manhole will permit.
4. The benches of the manhole outside of the channels shall be smooth and shall slope toward the channels at one (1) inch per foot.
5. Pipe size changes shall be accomplished by matching pipe crowns and forming the channel to accommodate the pipe size differential.
6. Where shown on the Drawings a piece of pipe of the proper size shall be built into the manhole where future laterals may be connected. This pipe shall be sealed with a plug at its outer end and an invert shall be built into each manhole for such lateral connections.
7. Manhole bases shall be thoroughly bonded to the barrel of the pipe. Provide a rubber gasket on pipe barrel for PVC pipe. All connections with pipe shall be made without projections or voids.
8. Inverts must meet the requirements of the Town.

B. Outside drop manholes.

1. Where difference in elevation between the incoming sewer and the manhole invert is less than eighteen (18) inches, the channel invert through the manhole shall be formed to make a smooth transition between the incoming and outgoing inverts.
2. Where the difference in elevation is eighteen (18) inches or more provide an outside drop pipe for the sewer entering the manhole.

C. Terminate pipe flush with interior manhole wall.

D. No modification of precast sections will be permitted on the job site. All such fabrication must be accomplished at the point of manufacture. Have manufacturer cut openings to receive entering pipes of sufficient size to provide 3/4 inch annular space around pipe or as required by manufacturer of penetration gaskets.

E. The manhole base shall be thoroughly cleaned, to prepare for the placing of the precast sections. Preformed plastic gaskets are to be applied to the precast section bearing seat.

- F. Set each manhole riser section plumb. Use sections of various heights to bring ring and cover to grade. Precast sections shall be carefully lowered so that the preformed plastic gasket is forced out from under the section evenly on all sides.
- G. Join manhole sections using preformed flexible plastic gaskets on both interior and exterior shiplaps. All joints surfaces shall be clean, dry, and warm during installation. Shiplaps shall be coated with a manufacturer approved primer prior to placement of flexible plastic gaskets.
- H. Fill all lifting holes and other imperfections with mortar. Neatly grout the inside and outside of all joints.
- I. Install rings and covers above cone or flat top of the manhole. Set ring in a full bed of mortar and encase in concrete around the entire perimeter.
- J. Manholes shall have a concrete ring constructed around the manhole frame in accordance with detail 3-4.

3.4 FIELD QUALITY CONTROL

- A. Sewer shall meet the requirements of the following tests. Furnish all equipment, labor and incidentals necessary and conduct tests in the presence of Town.
- B. Alignment/Integrity Tests.
 1. Each completed section of sewer main shall be videoed with closed circuit television. Connection to the existing sewer system shall also be videoed. Provide copy of CD or DVD and written sewer inspection log to Town.
 2. Contractor/Developer shall re-inspect all constructed sewer mains within development and development related off-site sewer with closed circuit TV inspection. The re-inspection shall occur twenty-three (23) months following the substantial completion date of the development.
 3. Repair/Replace poor alignment, displaced pipe, or other defects discovered.
- C. Air Tests.
 1. Preparation for tests: flush and clean the sewer line prior to testing. Plug and brace all openings in the main sewer line and the upper connections. Check all pipe plugs with a soap solution to detect any air leakage. If leaks are found release the air pressure, eliminate the leaks and start the test procedure over again.

2. Procedure of Test: Add air until the internal pressure of the sewer line is raised to approximately 4.0 psi gage at which time the flow of air shall be reduced and the pressure maintained between 3.5 and 4.5 psi gage for a sufficient time to allow the air temperature to come to equilibrium with the temperature of the pipe.
3. After the temperature has stabilized permit the pressure to drop to 3.5 psi gage at which time a stop watch or a sweep second hand watch shall be used to determine the time lapse required for the air pressure to drop to 2.5 psi gage.
4. The time elapsed shall not be less than:
 $t = 0.6439d$; where t = time in minutes

d = pipe diameter in inches

d inches	t minutes
8	0.52
10	0.64
12	0.77
15	0.97
18	1.16
21	1.35
24	1.55

5. Brace all plugs sufficiently to prevent blowouts and vent the pipeline completely before attempting to remove the plugs.
6. Provide pressurizing equipment with a relief valve set at 5 psi to avoid over-pressurizing and damaging an otherwise acceptable line.

D. Vacuum Testing.

1. Manholes shall be vacuum tested after assembly and prior to backfilling.
 - a Care shall be taken to create a seal between the vacuum base and the manhole rim. Pipe plugs shall be secured to prevent movement while the vacuum is drawn.
 - b A vacuum of 10 inches of mercury (Hg) shall be drawn. The time for the vacuum to drop to 9 inches of mercury shall be recorded.
 - c Acceptance shall be defined as when the time to drop to 9 inches meets or exceeds the following:

<u>Inside Diameter</u>	<u>Time to Drop 1" Hg</u>
4 ft.	60 seconds
5 ft.	75 seconds
6 ft.	90 seconds

- d If the manhole fails the test, make necessary repairs. Repairs and repair procedures must be acceptable to Town.
- e If preformed plastic gaskets are pulled out during the vacuum test, the manhole shall be disassembled and the gaskets shall be replaced.

E. Water testing is not allowed.

F. Manholes and pipe lines shall not have any visible leaks or damp spots.

G. Repair and retest lines and manholes that fail tests until satisfactory results are obtained.

3.5 CLEANING

A. Prior to substantial completion remove all accumulated construction debris, rocks, gravel, sand, silt and other foreign material from the sewer system. Use mechanical rodding or bucketing equipment as required. Any unsatisfactory work shall be removed and replaced in a proper manner. The invert of the sewer and manholes shall be left smooth, clean, and free from any obstructions throughout the entire line. Manhole rings and covers must be raised to finished grade before acceptance of the sewer.

B. Upon final inspection if any foreign matter is present in the system, flush and clean the sections of the line as required. Material shall be removed at the downstream manhole and not allowed to enter the clean sections of pipe or waste water treatment plant.

* * * END OF SECTION * * *

SECTION 02731
PIPE BURSTING FOR SEWER LINE

PART 1 GENERAL

1.1 DESCRIPTION

- A. This section addresses the procedures to be employed for rehabilitation or replacing existing pressure sanitary sewer pipelines by pipe bursting as identified on the Drawings, and replacing with new pipe.

1.2 RELATED WORK

- A. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Sections in Division 1 of these Specifications.
- B. Section 01000 – General Conditions
- C. Section 02622 – Fusible polyvinyl chloride pipe
- D. Section 02713 – Water Distribution and Transmission System

1.3 STANDARDS

- A. References to Standard Specifications shall be understood to mean the latest revision of said Specification as amended prior to the date of solicitation of bids, except as otherwise noted in the Contract Documents.

1.4 SUBMITTALS

- A. The Contractor shall provide certifications, shop drawings and samples for all materials specified for use on the project as specified in Section 01330 - Submittals.

1.5 EXPERIENCE

- A. The Contractor shall have prior experience with this type of installation, demonstrate proof of instruction by the licensor, or provide on-site services of the licensor until such time the Contractor's competency to perform the work is satisfactory to the Town and/or Engineer.

PART 2 PRODUCTS

2.1 PIPE

- A. Pipe shall be the diameter called out on the Drawings DR-18 fuse jointed polyvinyl chloride (FPVC). Refer to specification Section 02622 – Fusible Polyvinyl Chloride Pipe for pipe material handling and testing.

PART 3 EXECUTION

3.1 SAFETY

- A. The Contractor shall carry out operations in strict accordance with all applicable OSHA Standards. Particular attention is drawn to those safety requirements involving work entry into confined spaces. It shall be the Contractor's responsibility to familiarize and its employees with OSHA Standards and regulations pertaining to all aspects of the Work.

3.2 INSERTION AND RECEIVING EXCAVATIONS

- A. Before excavation is begun, it will be the responsibility of the Contractor to check with the various utility companies and determine the location of existing utilities in the vicinity of the work area. The Contractor at no cost to the Town, if required, will arrange temporary construction easement and/or right-of-way areas.
- B. Damage to utilities and the resulting repair, temporary service cost, etc., shall be borne by the Contractor. Access pits shall be backfilled in accordance with the appropriate specifications.
- C. All excavations shall be properly sheeted/shored in accordance with relevant Specifications for trench safety systems. Any damage resulting from improperly shored excavations shall be corrected to the satisfaction of the Engineer or Town with no compensation due to the Contractor.
- D. All open excavations shall be kept secure at all times by the use of barricades with appropriate lights and signs, construction tape, covering with steel plates, etc., or as directed by the Engineer or Town.
- E. One or more receiving pits shall be excavated at the end(s) of the pipe to be replaced or at appropriate points within the length of the existing pipe. Pit shall be centered over the existing pipe.

3.3 MATERIALS HANDLING

- A. No materials shall be dumped, dropped, pushed or rolled into a trench. Pipe may be pulled longitudinally into the trench after fusion of the pipeline. Pulling of the main shall be accomplished by mechanical action during pipe bursting operations.

3.4 LAUNCHING AND BURSTING PIT

- A. Pits shall be located along the alignment of the pipe. Deviations from the proposed locations shall be approved by the Engineer in advance of any excavation.

3.5 SERVICE PITS

- A. Pits shall be required to install service connection fittings and reconnect services to the newly installed pipe.

3.6 SERVICE LINE REPLACEMENT

- A. The Contractor shall provide and maintain a schedule for replacing service lines and method for replacing lines (directly connecting or directional drilling of new service lines).

3.7 PIT CONTAMINATION PREVENTION

- A. Pits shall be kept as dry as possible and shall be excavated to at least one (1) foot below the pipe invert to minimize the potential for contamination during connection of the new main and services.

3.8 PIPE JOINTING

- A. Sections of PVC replacement pipe shall be assembled and joined on the job site above the ground. Jointing shall be accomplished in strict conformance with the manufacturer's printed instructions.
- B. The Buttfusion method for pipe jointing shall be carried out in the field by certified operators with prior experience in fusing PVC pipe with similar equipment using proper jigs and tools per standard procedures outlined by the pipe manufacturer. These joints shall have a smooth, uniform; double rolled back bead made while applying the proper melt, pressure, and alignment. It shall be the sole responsibility of the Contractor to provide an acceptable buttfusion joint. The Contractor shall make all joints available for inspection before the insertion. The replacement pipe shall be joined on the site in appropriate working lengths near the insertion pit.

*** END OF SECTION***

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SECTION 02732
SANITARY SEWER SERVICE LINES

PART 1 GENERAL

1.1 DESCRIPTION

- A. This section covers the installation of sanitary sewer service lines plus the furnishing and installation of clean-outs, and other appurtenances.
- B. All changes in alignment require a clean-out.

1.2 QUALITY ASSURANCE

- A. Lay pipe at a minimum of two (2%) percent (1/4" per foot) slope. Under no circumstances shall pipe be laid which results in a level invert, reverse sloping invert, or a grade flatter than one (1%) percent (1/8" per foot).

1.3 JOB CONDITIONS

- A. Use effective measures to prevent foreign material from entering the pipe.
- B. Do not place debris, tools, clothing, or other materials in the pipe.
- C. Close the open end of any pipe with a plug, or cap, to prevent the entry of foreign material or water into the pipe.
- D. Use effective measures to prevent the uplift or floating of the line prior to completion of the backfilling operation.

PART 2 PRODUCTS

2.1 PIPE MATERIALS

- A. Type.
 - 1. PVC: Reference Section 02622.

2.2 FLEXIBLE COUPLINGS

- A. When joining pipes where conditions will not allow joining by use of a bell section.
 - 1. Can-Tex, C-T Adapters.
 - 2. Fernco, Flexible couplings or reducing couplings.

3. Jointers Inc., Calder Coupling.
4. Mission, Bushing Adapters.
5. Nashua Pre-Cast Corp., Flex-O-Joint.
6. Or approved equal.

2.3 BEDDING

- A. Refer to section 02221 Part 2.3

2.4 CLEANOUTS

- A. Lids in lawns shall be polyvinyl chloride material.
 1. Reference section 02622
- B. Lids in traffic areas shall be rated for traffic loading.

PART 3 EXECUTION

3.1 PIPE INSTALLATION

- A. Pipe Laying.
 1. Prior to installation of pipe, pothole existing stub-out and existing sewer service at proposed points of connection. Place new service line at a uniform grade between these points.
 2. Begin pipe laying at the lowest point, unless otherwise approved by Town, and install the pipe with the spigot ends pointing in the direction of flow.
 3. Lay pipe true to line and at a minimum grade of 2% (1/4" per foot).
 4. As each length of pipe is placed in the trench, complete the joint in accordance with the applicable pipe material specification and adjust the pipe to the correct line and grade. Make adjustments by scraping away or filling pipe bedding under the body of the pipe, and not by wedging or blocking up the bells.
 5. Secure the pipe in place with the specified bedding tamped under and around the pipe except at the joints. Do not use mechanical compacting equipment in the zone above the horizontal centerline of the pipe and below a plane 1 foot above the top of the pipe. Do not walk on small diameter pipe or otherwise disturb pipe after the jointing has been completed.

6. Clean-outs.
 - a Place top of clean-out at bottom of sod.
 - b Place horizontal section of clean-out in line with downstream alignment of service line.
 - c Maximum spacing on clean-outs: 100 feet.
 - d Clean-outs in traffic areas shall be designed to the approval of the Town.

B. Marking of Sanitary Service Connections

1. Sanitary service connections shall be marked with stamped 'S' in curb as shown in Service Wye Detail (DWG. REF. 3-7).

3.2 INSPECTION REQUIREMENTS

- A. During Town inspection of sanitary sewer service connection, Contractor shall be present on-site with building permit.

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SECTION 02740
GREASE AND SAND & OIL INTERCEPTORS

PART 1 GENERAL

1.1 DESCRIPTION

A. This section covers the selection and installation of grease interceptors and combination sand & oil interceptors.

1.2 PRODUCT DELIVERY, STORAGE AND HANDLING

A. All products shall be handled, stored, and protected in a manner which will prevent damage to materials.

PART 2 PRODUCTS

2.1 PRECAST CONCRETE PRODUCTS

A. All precast concrete products shall conform to ASTM C478 and shall be made with Type I/II cement.

2.2 CAST-IN-PLACE CONCRETE

A. All cast-in-place concrete shall be made with Type I/II Portland Cement conforming to ASTM C150.

2.3 MORTAR

A. Mortar shall be sand-cement grout, using the following ratio of ingredients.

1. One part Portland Cement; conforming to ASTM C150, Type I/II.
2. Two parts sand; conforming to ASTM C144
3. ½ part hydrated lime; conforming to ASTM C207, Type S.

2.4 GROUT

A. Grout shall be one of the following:

1. Pre-mixed, non-shrinking, and non-metallic grout; the acceptable types and manufacturers of which are listed below:
 - a. Master Builders; “Embeco Mortar”.

- b Sonneborn; “Ferrolith G-D.S Redi-Mixed”.
 - c Or approved equal.
2. Job mixing grout, using the following ratio of ingredients:
- a One part Portland Cement; conforming to ASTM C207, Type I/II.
 - b One part sand; conforming to ASTM C144.
 - c One part shrinkage correcting aggregate; the acceptable types and manufacturers of which are listed below:
 - i. Master Builders; “Embeco Aggregate”.
 - ii. Sonneborn; “Ferrolith G-D.S”.
 - iii. Or approved equal.

2.5 RING AND COVER

A. Acceptable ring and covers are:

- 1. Neenah, R-1706- smooth surface stamped sewer
- 2. Or approved equal.

2.6 STEPS

A. All steps shall be made of one of the following materials:

- 1. Copolymer polypropylene plastic, conforming to ASTM C478 and ASTM C497.

B. Acceptable steps and their manufacturers are:

- 1. M.A. Industries; PS-2-PFS.
- 2. Or approved equal.

C. All steps shall be spaced vertically 12-inches apart, on center.

PART 3 GREASE INTERCEPTORS AND TRAPS

3.1 GENERAL

A. Unless written approval is given by the Town, all food serving, food preparing, food catering, meat cutting establishments; fish, fowl, animal

slaughter houses, soap factory, tallow rendering, fat rendering, hide curing establishments; and others capable of discharging large amounts of grease into the sanitary sewer system, shall be required to install a grease interceptor.

- B. Grease interceptors shall not be required for private residences or dwellings.
- C. Owners of businesses that may require grease interceptors shall submit plans to the Town for review and approval.

3.2 LOCATION OF GREASE INTERCEPTORS

- A. Unless prior permission is given by the Town, all grease interceptors shall be located outside of the building, on private property, within thirty (30) feet of the facility served, and shall be easily accessible at all times for maintenance and examination.
- B. All grease interceptors shall have two compartments, the smallest of which shall have at least one-third the capacity of the entire interceptor.

3.3 SIZE OF GREASE INTERCEPTORS

- A. The size of grease interceptors shall be determined by the owner of the facility.
 - 1. If the seating capacity of the restaurant can be determined, the following method of sizing shall be used.
 - a. Number of seats times a full capacity factor of 0.9 times a turnover rate of 2.2 per meal period equals the number of meals served per meal period.
 - b. Number of meals per meal period times 2.5 gallons per meal equals the required volume of the
 - c. For example:
 $214 \text{ seats} \times 0.9 = 192.6 \text{ estimated full capacity}$
 $192.6 \times 2.2 = 423.7 \text{ estimated meals per period}$
 $423.7 \times 2.5 = 1059.3 \text{ gallons}$
 - d. If the required volume is within 10% of a smaller approved precast grease interceptor, the smaller unit will be acceptable.
 - 2. If food is prepared but not consumed on the premises, or if the seating capacity cannot be determined, the following method of sizing shall be used.

- a A fixture unit (F.U.) count for the various pieces of kitchen equipment shall be determined following the methods outlined in the Uniform Plumbing Code.
- b The total number of fixture units times 7.5 gallons per minute equals the maximum flow rate.
- c The maximum flow rate times 8.0 equals the required volume of the grease interceptor.
- d For example:

1 dishwasher	=	3 fixture units (F.U.)
1 3-compartment sink	=	3 F.U.
1 mop sink	=	3 F.U.
1 floor drain	=	2 F.U.
Total	=	11 F.U.

11 F.U. x 7.5 gpm x 8 minute retention = 660 gallons.
- e If the required volume is within 10% of a smaller approved precast grease interceptor, the smaller unit will be acceptable.

3.4 IN-LINE GREASE TRAPS

- A.** In-line grease traps shall be permitted by the Town only where it is impractical to install a larger type grease interceptor outside.
 - 1. A location of a restaurant above the first floor of its building shall not be considered a sufficient reason to allow an in-line grease trap.
- B.** The size of in-line grease traps shall be determined by one of the following methods.
 - 1. The number of fixture units, as determined following the methods outlined in the Uniform Plumbing Code, times 7.5 gallons per minute times a 1.5 minute retention time equals the required volume of the in-line grease trap.
 - a No more than two (2) fixtures shall be connected to the same in-line grease trap.
 - b Dishwashers shall not be connected to the in-line units.
 - c Food disposals shall not be connected to the in-line units.
 - 2. The size of in-line grease traps for school kitchens shall be determined as follows.

- a Number of students times 0.6 equals the average daily participation in the school lunch program.
 - b Average daily participation times 2.5 gallons per meal served equals the required volume of the in-line grease trap.
 - c For example:
 - $650 \text{ students} \times 0.6 = 390 \text{ meals served}$
 - $390 \times 2.5 = 975 \text{ gallons}$
3. In-line grease traps shall be rated according to the flow rate that they can accommodate.
- a The number of pounds shall equal twice the flow rate of the in-line unit.
 - i For example, a 100 gpm unit shall have a 200 pound capacity.
4. In-line grease traps rated at less than 20 gpm/40 lbs. capacity shall not be allowed.
- C. All in-line grease traps shall be constructed of either steel or cast iron, and shall have a full gas-tight cover.
- 1. Water jacketed in-line grease traps shall not be allowed.

PART 4 COMBINATION SAND & OIL INTERCEPTORS

4.1 GENERAL

- A. Unless written permission is obtained from the Town, all service stations, truck or car wash facilities, vehicle maintenance facilities, machine shops and others where significant amounts of sand, oil and/or flammable wastes could enter the sanitary sewer system, shall be required to install a combination sand & oil interceptor.
 - 1. Reference the Uniform Building Code.
- B. Owners of businesses that may require sand & oil interceptors shall submit plans to the Town for review and approval.

4.2 LOCATION OF COMBINATION SAND & OIL INTERCEPTORS

- A. All combination sand & oil interceptors shall be located outside of the building, on private property, within thirty (30) feet, and not less than five (5)

feet, of the facility served and shall be accessible at all times for maintenance and examination.

- B. All combination sand & oil interceptors shall have two compartments, the smallest of which shall have at least one-third the capacity of the entire interceptor.

4.3 SIZE OF COMBINATION SAND & OIL INTERCEPTORS

- A. The size of combination sand & oil interceptors shall be determined by the owner of the facility.

1. A fixture unit (F.U.) count for the various drains shall be determined following the values listed below:
 - a Three (3) inch diameter floor drains shall be rated at six (6) fixture units.
 - b Four (4) inch diameter floor drains shall be rated at eight (8) fixture units.
 - c If trough drains are used, each bay, or compartment, or area equaling the square foot surface of a standard service station bay which is served by the trough drain shall be rated at six (6) fixture units per bay.
 - d Vehicle wash drains shall be rated at eight (8) fixture units, regardless of the size.
2. The total number of fixture units times 7.5 gallons per minute equals the maximum flow rate.
3. The maximum flow rate times a 5 minute retention time equals the required volume of the sand & oil interceptor.
4. For example: 2 3-inch floor drains = 12 fixture units
 $12 \text{ F.U.} \times 7.5 \text{ gpm} \times 5.0 \text{ minute retention} = 450 \text{ gallons}$

- B. Combination sand & oil interceptors smaller than 320 gallons will not be allowed.

PART 5 VENTING

5.1 GENERAL

- A. All grease interceptors, with the exception of in-line traps, and combination sand & oil interceptors shall be vented.

5.2 MATERIALS

A. Acceptable materials for vent pipe are:

1. Cast Iron
2. Copper
3. Brass
4. There will be no substitutions allowed.

B. Acceptable materials for vent fittings are:

1. Cast Iron
2. Copper
3. Brass
4. ABS
5. PVC
6. There will be no substitutions allowed.

C. Galvanized wrought iron and galvanized steel pipe and fittings will not be allowed underground.

D. Changes in the direction of vent piping shall be made by the appropriate use of fittings, and no such piping shall be strained or bent.

1. Burred ends shall be reamed to the full bore of the pipe.

5.3 SIZE OF VENTS

A. The size of vent piping shall be determined from its length and the total number of fixture units connected, as shown in the following chart.

Venting for grease and combination sand & oil interceptors

Pipe Diameter	Fixture Units	Lengths (Max. Allowable)
1 - ¼"	1 F.U.	45
1 - ½"	8 F.U.	60
2"	24 F.U.	120
2 - ½"	48 F.U.	180
3"	4 F.U.	212
4"	256 F.U.	300
5"	600 F.U.	390
6"	1380 F.U.	510

1. The minimum size of vent piping shall be 3 - inches for all grease interceptors and all combination sand & oil interceptors.

B. A vent may exceed 1/3 of the maximum horizontal length as limited by the above chart, only if the vent is increased one pipe size for its entire length.

5.4 VENT PIPE GRADES AND CONNECTIONS

A. All vent pipes shall be free of drops or sags.

B. All vent pipes shall be level, or graded in such a manner to drip back by gravity to the drain pipe that the vent pipe serves.

C. Vent pipes which connect to a horizontal drainage pipe shall be connected above the center line of the drainage pipe, and ahead of the trap being served.

D. All vent pipes shall rise vertically to a point not less than six (6) inches above the flood level rim of the structure being served before off setting horizontally.

1. When two or more vent pipes converge, each pipe shall rise to a point at least six (6) inches above the flood level rim before being connected to any other vent pipe.

E. All vent pipes which serve in-line grease interceptors shall extend undiminished in size until above the roof.

1. Weather heads will not be allowed.

2. All vent pipes shall terminate at a point not less than ten (10) inches above the roof vertically, and not less than one (1) foot from a vertical surface.

3. All vent pipes shall terminate at a point not less than ten (10) feet horizontally nor less than three (3) feet vertically from any window, door, air intake, vent shaft, or any other type of opening.

* * * END OF SECTION * * *

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DIVISION 4 –
STORM DRAINAGE

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SECTION 01030

STORM DRAINAGE IMPROVEMENTS

PART 1 MINIMUM DESIGN CRITERIA

1.1 GENERAL

- A. Except where specified herein, the procedure, criteria, and standards set forth in the Denver Regional Council of Governments' Urban Storm Drainage Criteria Manual will be used for analysis of drainage systems. Two (2) year intensities shall be used for minor storm analysis and 100-year intensities for major storm analysis. Other criteria may be outlined as determined by the Town on a project by project basis.
- B. Reference rainfall intensity chart and graph, found in pages 4 and 5 of this Section, to obtain data for Storm Drainage Analysis.
- C. The runoff analysis for a particular area shall be based on the zoned land use for that area. Contributing runoff from upstream areas shall be based on the existing land use and topographic characteristics of those areas. It is the responsibility of the downstream landowner to convey all existing major storm runoff through their property. All runoff calculations shall be based on the master drainage plan for the area, if one is available.
- D. Natural topographic features shall be the basis of location for easements and future runoff calculations. In developed and undeveloped areas average land slopes may be utilized in runoff computations. Wherever existing drainage patterns and slopes are defined, these shall be used. The drainage facilities so designed must be able to handle the design flows with virtually no erosion damage to the system.
- E. Streets shall not be used as primary floodways for storm runoff.
- F. Natural drainageways are to be used whenever feasible. Alteration to natural drainage patterns will be approved if a thorough investigation and analysis shows no hazard or liability.
- G. The planning and design of the drainage system shall not be such as to simply transfer the problem from one location to another or create a more hazardous condition downstream or upstream. Although improvements may not have to be made upstream or downstream of a subdivision, provisions shall be made in every subdivision for the 100-year storm to pass through that subdivision.

- H. All drainage improvements shall be as natural in appearance as possible to be aesthetically pleasing.
- I. Provide maintenance access for all drainage and flood control facilities.
- J. Irrigation ditches shall not be used as the outfall of any drainage basin unless it is possible to do so without hazard to liability and with the express written consent of the drainage ditch authority.
- K. Where a master drainage plan for a given area of the Town is available, proposed drainage systems shall conform to the plan. In areas where a master plan is not available, major drainageways and easements shall be located in order to provide continuity with existing drainage conditions. These drainageways and easements shall be shown on all drainage plans.
- L. Drainage design should consider and not impair surface or subsurface drainage.
- M. Maximum side slopes on detention ponds will be four horizontal to one vertical (4:1). A variance requested to a steeper side slope may be possible with Town approval.

1.2 FUTURE EXTENSION

- A. When a storm drain line is anticipated to be extended at a future date, the end of the line shall have a manhole and a plugged stub out installed in the direction(s) of extension. All extension lengths shall be subject to the approval of the Town.

1.3 MANHOLE SIZE AND SPACING

- A. Manholes should be located at all changes in grade, pipe sizes, and alignment.
 - 1. For changes in pipe size, the crowns of the pipes shall be at the same elevation, or the drop across the manhole between the incoming and outgoing flow shall be 0.2 feet whichever is greater.
 - 2. Manholes that do not have a change in alignment or pipe size shall have a drop across the manhole between the incoming and outgoing flow of 0.1 feet minimum.
 - 3. When a tee invert is constructed, the invert coming into the straight through channel must be at least two tenths of a foot (0.2') higher than the out invert.
 - 4. No curved storm drainpipe may be used.

5. Manholes shall be located at street intersections whenever possible.

- B. Manholes are to be four (4) feet in diameter for pipe up to and including eighteen (18) inches; larger pipe will require manholes with a five (5) foot diameter or greater.
- C. Manholes must be spaced no farther than four hundred (400) feet apart.
- D. Manholes must be located in areas that allow direct access via all-weather drives by maintenance vehicles.

1.4 INLETS

- A. Inlets shall be located to intercept the major curb flow. Due to the presence of handicap ramps, inlets are not allowed in the curb return. Multiple inlets shall be located at the tangent points of the curb returns.

1.5 CULVERTS

- A. The maximum culvert headwater to diameter ratios are:

<u>STORMWATER FREQUENCY</u>	<u>HEADWATER TO DIAMETER (HW/D)</u>
10-Year	$HW/D \leq 1.0$
100-Year	$HW/D \leq 1.5$

The minimum culvert capacities are:

<u>DRAINAGE CLASSIFICATION</u>	<u>MINIMUM CAPACITY (RECURRENCE INTERVAL)</u>
Local	2-Year
Residential Collector & Commercial Collector	10-Year
Minor Arterial & Major Arterial	100-Year

- B. When the flow in a roadside ditch exceeds the capacity of the culvert and overtops the cross street, the flow over the crown shall not exceed the limits established within the Streets Section.
- C. The required size of the culvert shall be based upon adequate hydraulic design analysis. However, to minimize maintenance requirements, the minimum allowable culvert size for culverts crossing under rural roads shall be 18" for

circular culverts or a minimum cross-sectional area of 1.77 square feet. For driveway culverts in roadside ditches, the minimum size shall be 15" for circular culverts or a 1.23 square foot cross-sectional area.

1.6 ENERGY AND HYDRAULIC GRADE LINE

- A. The hydraulic grade line and energy grade line shall be determined for each culvert system and included in the Final Drainage Report. Each culvert system shall be profiled on the Final Construction Drawings and shall include the design flow hydraulic grade line.

1.7 PROJECTING INLETS

- A. At a minimum, a culvert entrance and outlet shall include a flared end section.

1.8 STREETS

- A. Reference Chapter 1 Volume 1 UDFCD Streets Inlet Storm Sewers for design criteria.

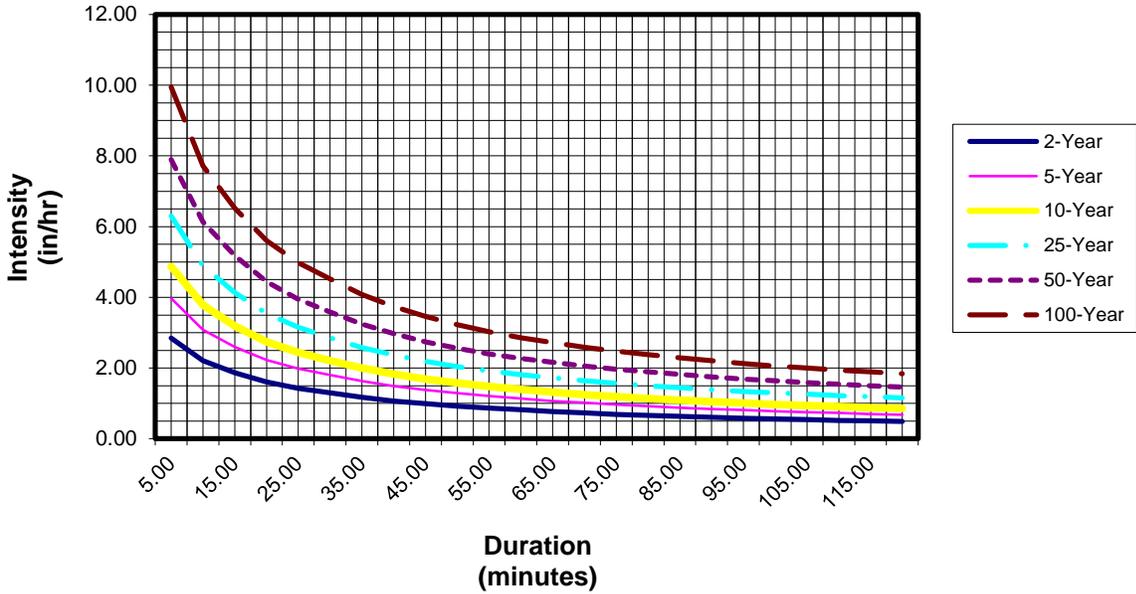
1.9 DETENTION / WATER QUALITY

- A. Reference Chapter 10 Volume 2 UDFCD- Storage for all detention and water quality design criteria except as noted below.
- B. Detention ponds shall be designed to restrict developed storms to historic levels for the 2-year and 100-year storm events for residential sites and the 10-year and 100-year storm events for all other development site including mixed use.
- C. Water Quality Control Volume (WQCV) shall be included as part of the 100-year detention volume.
- D. Ponds and onsite drainage infrastructure shall be designed to pass any offsite flows safely through the site.
- E. Maintenance of ponds located on private property will be the responsibility of the property owner unless otherwise provided for in a development agreement between the developer and the Town.
- F. Refer to the checklist below for additional information on detention design criteria.

Criterion/Requirement	
Side slopes must be 4:1 or flatter.	
Embankment (dam fill) slopes must be 3:1 or flatter.	
Trickle channels will be required for detention ponds, wetland bottom ponds or “wet” water quality ponds.	
The longitudinal slope for trickle channels shall be at least 0.5% for concrete bottoms and at least 1% for other bottoms.	
The pond bottom cross slope shall be at least 2%.	
Maintenance access ramps to the pond bottom must be at least 8 feet wide and have a 10% or flatter slope.	
Provide an emergency spillway for flows that exceed primary outlet capacity. Provide a minimum 1-foot freeboard.	
Outlet structures must meter the discharges to historic levels. Provide trash racks that do not interfere with the hydraulic capacity of the outlet.	
Tributary inflow points to the ponds shall be adequately protected to prevent erosion.	
Designs shall consider the safety of the public.	
Provide a pre-sedimentation forebay and account for sediment accumulation in the WQCV.	
Geotechnical considerations (embankment stability, geologic hazard, seepage) are taken into account.	
Vegetation takes into account frequency and duration of inundation.	

RAINFALL INTENSITY-Duration-Frequency Table						
Town of Wellington Standards						
Duration Minutes	2-YEAR Intensity (in/hr)	5-YEAR Intensity (in/hr)	10-YEAR Intensity (in/hr)	25-YEAR Intensity (in/hr)	50-YEAR Intensity (in/hr)	100-YEAR Intensity (in/hr)
5.00	2.85	3.97	4.87	6.30	7.90	9.95
10.00	2.21	3.08	3.78	4.89	6.13	7.72
15.00	1.87	2.60	3.19	4.13	5.18	6.52
20.00	1.61	2.23	2.74	3.54	4.44	5.60
25.00	1.43	1.98	2.44	3.15	3.95	4.98
30.00	1.30	1.80	2.21	2.86	3.59	4.52
35.00	1.17	1.63	2.00	2.58	3.24	4.08
40.00	1.07	1.49	1.83	2.37	2.97	3.74
45.00	0.99	1.38	1.69	2.19	2.74	3.46
50.00	0.92	1.29	1.58	2.04	2.56	3.23
55.00	0.87	1.21	1.48	1.92	2.40	3.03
60.00	0.82	1.14	1.40	1.81	2.27	2.86
65.00	0.77	1.07	1.32	1.72	2.16	2.72
70.00	0.73	1.02	1.25	1.64	2.06	2.59
75.00	0.69	0.97	1.19	1.57	1.97	2.48
80.00	0.66	0.92	1.14	1.50	1.89	2.38
85.00	0.63	0.88	1.09	1.44	1.82	2.29
90.00	0.61	0.84	1.05	1.39	1.75	2.21
95.00	0.58	0.81	1.01	1.34	1.69	2.13
100.00	0.56	0.78	0.97	1.30	1.64	2.06
105.00	0.54	0.75	0.94	1.26	1.59	2.00
110.00	0.52	0.73	0.91	1.22	1.54	1.94
115.00	0.51	0.70	0.88	1.19	1.50	1.89
120.00	0.49	0.68	0.86	1.16	1.46	1.84
150.00	0.43	0.60	0.75	0.86	1.05	1.19
180.00	0.39	0.52	0.65	0.75	0.89	1.05

Town of Wellington, Colorado
Rainfall Intensity-Duration-Frequency Curve



* * * END OF SECTION * * *

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SECTION 02612
REINFORCED CONCRETE PIPE

PART 1 GENERAL

1.1 DESCRIPTION

- A. This section covers reinforced concrete (RCP) pipe complete with jointing materials and other appurtenances.
- B. Non-reinforced pipe is not allowed.

PART 2 PRODUCTS

2.1 PIPE

A. General.

- 1. Strength: as indicated on the Drawings. (Minimum strength class is III).
- 2. Cement: Type II
- 3. Minimum pipe size: 15 inches.
- 4. Absorption rate shall not exceed 5.5 percent.

B. Circular reinforced concrete pipe: ASTM C76

C. Elliptical reinforced concrete pipe: ASTM C507

D. Arch culvert reinforced concrete pipe: ASTM C506

2.2 Markings:

- A. Each pipe shall be plainly and permanently marked showing the pipe class, date of manufacture, and the manufacturer's name or mark. These markings shall be made on the outside of the pipe before curing or shall be painted on the pipe using waterproof paint.

2.3 JOINTS

A. Type: ASTM C443, rubber gasket (R-4 joint)

B. Pipes with collars in lieu of internal, integral cast bells are not acceptable.

C. Gasket material: Neoprene or other synthetic rubber

PART 3 EXECUTION

3.1 INSPECTION

- A. Examine pipe upon delivery and do not use individual sections with any defect, including the following:
 - 1. Fractures or cracks passing through the wall.
 - 2. Defects that indicate imperfect proportioning, mixing, and molding.
 - 3. Surface defects indicating honeycombed or open texture.
 - 4. Damaged or cracked ends where such damage would prevent making a satisfactory joint.
 - 5. Continuous cracks having a surface width of 0.01 inch or more extending for a length of 12 inches or more regardless of position in the pipe wall.

- 3.2 Mark defective pipe and store on site at a separate location away from the Work until after acceptance of the piping system at which time it shall be removed from the site.

3.3 INSTALLATION

- A. Lay pipe true to line and grade.
- B. As each length of pipe is placed in the trench, complete the joint and adjust the pipe to the correct line and grade. Make adjustments by scraping away or filling pipe bedding under the body of the pipe, and not by wedging or blocking.
- C. Lay pipe upgrade from the lowest point, with the bell end pointing upgrade.

3.4 JOINTING OF PIPES

- A. Join in accordance with pipe manufacturer's recommendations and gasket manufacturer's recommendations.

* * * END OF SECTION * * *

SECTION 02618

CORRUGATED METAL PIPE

PART 1 GENERAL

1.1 DESCRIPTION

- A. This section covers the furnishing and installation of corrugated metal pipe and fittings.
- B. Corrugated metal pipe may be used for culvert pipe but shall not be used for storm drainage pipe in a storm drain system under public roadways.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Conformance: Colorado Department of Transportation, Division of Highways, "Standard Specifications for Road and Bridge Construction" and the applicable provisions of the M Standard Plans of the Colorado Department of Highways, Division of Highways, State of Colorado. Sections 100 through 109 of the Specifications and measurement and payment provisions shall not apply.
- B. Corrugated steel pipe and pipe arch shall meet the requirements of Section 707.02 of the Standard Specifications.
- C. Bituminous coated corrugated steel pipe and pipe arch shall meet the requirements of Section 707.03 of the Standard Specifications.
- D. Corrugated aluminum pipe and coupling bands shall meet the requirements of Section 707.06 of the Standard Specifications.
- E. Extensions shall meet the requirements of Section 707.08 of the Standard Specifications.

PART 3 EXECUTION

3.1 INSPECTION

- A. Examine the pipe and fittings for defects. Mark defective pipe and store on site at a separate location away from the work until after acceptance of the piping system at which time it shall be removed from the site.

3.2 INSTALLATION

- A. Do not deviate from grade more than 1/4 inch. Said deviation shall not result in a level or reverse sloping invert.
- B. As each length of pipe is placed in the trench, complete the connection and adjust the pipe to the correct line and grade. Make adjustments by scraping away or filling pipe bedding under the body of the pipe, and not by wedging or blocking.

* * * END OF SECTION * * *

SECTION 02626
PLASTIC STORM DRAINAGE PIPE

PART 1 GENERAL

1.1 DESCRIPTION

- A. This section covers plastic pipe to be used for the storm drainage culverts.
- B. Plastic storm drainage pipe may be used for culvert pipe and sub drainage pipe with the approval of the Town but shall not be used for storm drainage pipe in a storm drain system under public roadways without explicit approval from the Town.

PART 2 PRODUCTS

2.1 NON-PERFORATED CULVERT PIPE

- A. Polyethylene corrugated pipe and fittings: ASTM F405 with ultra-violet resistant pigment for sizes 3 inches through 6 inches.
 - 1. Pipe shall have a smooth interior.
- B. Polyethylene corrugated pipe and fittings: ASTM F667 with ultra-violet resistant pigment for sizes 8 inches through 24 inches.
 - 1. Pipe shall have a smooth interior.
 - 2. Pipe ends shall contain a gasketed bell and spigot joining system. No split coupling joining systems will be allowed.
- C. Polyvinyl chloride ribbed pipe and fittings: ASTM F794 for sizes 4 inches through 48 inches.
- D. High Density Polyethylene (HDPE) for sizes 4 inch to 60 inch.
 - 1. Pipe shall have a smooth interior.
 - 2. Pipe ends shall contain a gasketed bell and spigot joining system. No split coupling joining systems will be allowed.

2.2 PERFORATED CULVERT PIPE

- A. Polyethylene corrugated pipe and fittings: HDPE, meeting the requirements of ASTM F405 for sizes 3 inches through 6 inches.

- B. Polyethylene corrugated pipe and fittings: HDPE, meeting the requirements of ASTM F667 for sizes 8 inches through 24 inches.
- C. Pipe exposed to sunlight shall be constructed with ultra-violet resistant pigment.
- D. Geotextile: CDOT, Section 712.08, Class A Table 712-3.

PART 3 EXECUTION

3.1 INSPECTION

- A. Examine pipe and fittings and do not use individual sections containing:
 - 1. Cracks.
 - 2. Dents.
 - 3. Abrasions.
 - 4. Other defects.
- B. Mark rejected pipe, store at a designated remote spot on site, and remove from the site after completion of the project.

3.2 INSTALLATION

- A. Cutting the pipe.
 - 1. Cut pipe square with saw or pipe cutter designed specifically for the material.
 - 2. Bevel the end in accordance with the manufacturer's recommendations.
- B. Insert the spigot to the reference mark, according to manufacturer's recommendations.
- C. Do not disturb previously installed joints during jointing operations.
- D. Pipe shall be centered horizontally in the trench.
- E. Wrap the bedding material of perforated culvert pipe with geotextile fabric.

* * * END OF SECTION * * *

SECTION 02720
STORM DRAINAGE SYSTEM

PART 1 GENERAL

1.1 DESCRIPTION

A. This section covers the installation and testing of storm drainage systems including the furnishing and installation of manhole and inlet materials, and other appurtenances.

1.2 QUALITY ASSURANCE

1.3 Lay pipe and set manhole inverts true to line and grade shown on Drawings. Under no circumstances shall pipe be laid which results in a level invert, reverse sloping invert, or a grade flatter than will accommodate design flows.

1.4 JOB CONDITIONS

A. A. Use effective measures to prevent foreign material from entering the pipe.

B. B. Do not place debris, tools, clothing, or other materials in the pipe.

C. C. Close the open end of any pipe with a plug, or cap, to prevent the entry of foreign material or water into the pipe.

D. D. Use effective measures to prevent the uplift or floating of the line and manholes prior to completion of the backfilling operation.

PART 2 PRODUCTS

2.1 PIPE MATERIALS

A. Type.

1. Reinforced Concrete Pipe: Reference Section 02612.

2. Corrugated metal pipe and plastic pipe may only be used as culvert pipe and not as part of the storm drainage system. Reference Section 02618.

B. Minimum size will be 15-inch diameter.

C. Flared end sections shall be manufactured flared end sections and shall meet the minimum material specification applying to the pipe.

2.2 MANHOLE MATERIALS

- A. Same as sewer manholes, reference Section 02730, except only one preformed plastic gasket is required per joint. Cast word "Storm" in the cover.

2.3 CONCRETE

- A. See Sections 02520 and 02528.

2.4 INLETS

- A. All inlets shall conform to the Colorado Department of Transportation, Division of Highways, M - Standards. "Standard Specifications for Road and Bridge Construction" sections 100 through 109 and measurement and payment provisions shall not apply.
- B. Street inlet grates shall be of a design that is safe for bicycles.

2.5 PIPE BEDDING

- A. All pipe, regardless of type or diameter, shall be installed on sufficient bedding material so as to provide a minimum of three (3) inches separation between the subsoil and the pipe bell, after consolidation. In addition, all bedding and backfill material shall be free of frozen material, organic material, and debris.
- B. Bedding materials shall not contain cinders or other material that may cause pipe corrosion.
- C. A concrete arch encasement is not required unless improper trenching or unexpected trench conditions require its use, as determined by the Engineer.

2.6 Fully Embedded Pipe (Corrugated Metal Pipe (CMP) & Plastic Storm Drain):

- A. HDPE, CMP, and PVC regardless of diameter, shall be enveloped with consolidated bedding material between the trench banks and to a cover above the pipe of not less than twelve (12) inches. French or perforated underdrains shall be fully embedded in the pipe foundation stabilizer material to six (6) inches each side of the pipe unless otherwise detailed on the drawings.

2.7 Partially Embedded Pipe (Reinforced Concrete Pipe):

- A. Reinforced concrete and prestressed concrete cylinder pipe, shall be bedded to springline with consolidated bedding material between the trench banks.

2.8 Storm Drain Pipe

- A. Granular Bedding Material: Angular crushed rock conforming to CDOT #67.

Sieve Size or Designation	Total Passing (% by Weight)
1"	100%
3/4"	90-100%
3/8"	20-55%
#4	0-10%
#8	0-5%

PART 3 EXECUTION

3.1 CONNECTION TO EXISTING SYSTEM

- A. The physical connection to the existing storm drain system shall be plugged at the first downstream manhole until the storm system has been completed to the satisfaction of the Town. If improper construction methods or materials are used, or excess infiltration occurs, the Town may require the system be plugged until satisfactory corrections are made. Two (2) working days notice must be given prior to any connection to the existing system.

3.2 PIPE INSTALLATION

- A. All trenching shall be in accordance with Section 02221 under the water line specifications.
- B. Pipe Laying.
1. Begin pipe laying at the lowest point, unless otherwise approved by the Town, and install the pipe with the spigot ends pointing in the direction of flow.
 2. Lay pipe true to line and grade.
 3. As each length of pipe is placed in the trench, complete the joint in accordance with the applicable pipe material specification and adjust the pipe to the correct line and grade. Make adjustments by scraping away or filling pipe bedding under the body of the pipe, and not be wedging or blocking up the bells.
 4. Secure the pipe in place with the specified bedding tamped under and around the pipe except at the joints.

3.3 MANHOLE CONSTRUCTION

- A. Same as sewer manholes, reference Section 02730.

- B. Provisions as to placement, access, and water tightness of manholes from surface drainage is the same as for sewer manholes. Storm sewer manholes do not require vacuum testing.
- C. Manhole Frame shall have a reinforced (fiber mesh and #3 rebar) concrete collar around the ring. Collar shall extend 12" beyond the outer edge of ring all the way around ring.

3.4 STORM INLET CONSTRUCTION

- A. All concrete and steel reinforcing used and all concrete work done in constructing inlets shall be in accordance with the Colorado Department of Transportation, Division of Highways, "Standard Specifications for Road and Bridge Construction" and M - Standards. Specifications sections 100 through 109 and measurement and payment provisions shall not apply.
- B. All casting used shall sit flush with the surrounding concrete apron.
- C. The bottom of all inlet structures shall be formed to drain to the outlet pipe at a minimum slope of 1 inch per linear foot.
- D. All inlet structures will be flushed after completion and will not be accepted if water remains in the structure.
- E. The minimum size of the outlet pipe from the inlet structure shall be eighteen (18) inches in diameter.

3.5 FIELD QUALITY CONTROL

- A. System shall meet the requirements of the following tests. Furnish all equipment, labor and incidentals necessary and conduct tests in the presence of Town.
- B. Alignment Tests:
 - 1. Lamp each section of lines between manholes to determine whether any displacement of the pipe has occurred.
 - 2. Repair poor alignment, displaced pipe, or other defects discovered.
- C. Manholes and pipe lines shall not have any visible leaks or damp spots.
- D. Compaction Testing:
 - 1. Maximum dry densities of all soil types encountered or to be used will be determined in accordance with AASHTO T-99 or T-180 Methods C-D. The percent of Standard Proctor compaction required will be equal to or

greater than minimum values as hereinafter shown for the various classes of soil and type of compactions.

AASHTO T-99 AASHTO T-180 Soil Classification AASHTO M-145	Minimum Standard Proctor Compaction	Minimum Relative Compaction
A-1-granular	100	95
A-3- Granular	100	95
A-2-4- granular	100	95
A-2-5- Granular	100	95
All Others - Silty Clay	95	90

2. Compacted subgrade ready to receive subbase material shall conform to the lines, grades and cross-section called for on the Drawings. Subgrade is to be established by survey.

3.6 CLEANING

- A. Prior to substantial completion remove all accumulated construction debris, rocks, gravel, sand, silt and other foreign material from the system. Use mechanical rodding or bucketing equipment as required. Any unsatisfactory work shall be removed and replaced in a proper manner. The invert of the storm drain and manholes shall be left smooth, clean, and free from any obstructions throughout the entire line. Manhole rings and covers must be raised to finished grade before acceptance of the storm drain.
- B. Upon final inspection if any foreign matter is present in the system, flush and clean the sections of the line as required.

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**DIVISION 5 –
STREETS**

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SECTION 1041

STREET DESIGN AND TECHNICAL CRITERIA

PART 1 GENERAL

This part defines layout criteria and other design criteria that shall be followed for locating and designing all streets. The chapter provides the following information:

- How streets are to be located (layout criteria);
- Street classifications and purposes;
- Minimum design criteria that must be met; and
- Intersection design criteria.

1.1 Conforming to Standards and Master Plans

The Project's street design and layout shall conform to these Standards and with the Wellington Transportation Master Street Plan and other applicable plans, codes and standards adopted by Wellington. Design of roads and streets shall conform to the CDOT Roadway Design Manual (latest edition) and Standards Plans, M and S Standards (latest edition) except as indicated herein or in other Wellington codes and standards.

1.2 Construction Drawings Relating to this Section

The Construction Drawings included at the end of this section are a part of these Standards.

PART 2 STREET LAYOUT REQUIREMENTS

The locations of Collector and Arterial streets shall be in accordance with the Master Street Plan. Other streets shall be located in accordance with all other applicable street layout requirements.

2.1 Master Planned Arterial and Major Collector Streets

All streets shall have a logical relationship to the existing topography and to the location of existing or platted streets within adjacent properties. Certain streets within the Project may need to be extended to the Project boundary to provide for the future logical extension of the street through adjacent properties.

2.2 Local and Minor Collector Streets

Layout of new Local streets and Collector streets not covered by Wellington's Master Street Plan shall meet the needs of the specific development and satisfy all other specific requirements of this Section. Wellington retains the authority to

designate Collector streets and retains authority for approval of the overall street layout.

PART 3 STREET CLASSIFICATIONS

All streets are classified as Arterial, Collector (Major and Minor) or Residential Local. These classifications relate to the function of the streets. Lower order streets function primarily as access to individual lots, and higher order streets function primarily for the purpose of mobility (expeditious movement of people and goods).

3.1 Street Classifications

Drawing References 5-1 through **5-4**, located at the end of these Standards, show street classifications and specific requirements for Wellington. **Table 5-1** provides a summary of the classification requirements. Classifications and related drawing reference numbers are as follows:

<u>Drawing Reference</u>	<u>Street Classification</u>
5-1	Arterial Street
5-2	Major Collector Street
5-3	Minor Collector Street
5-4	Residential Local Street

- A.** Arterial streets are to move traffic from one location to another location.
- B.** Collector streets are to gather the traffic from a subdivision and surrounding area and carry it to Arterial streets. The primary points of access to a subdivision should be a Collector street. Design Collector streets to penetrate and adequately serve subdivision areas.
- C.** Residential Local streets are all streets that are not Collector streets or Arterials. Residential Local streets should be designed to direct traffic to Collector streets and adequately provide for circulation and movement within a subdivision.
- D.** Alleys may be used to provide secondary vehicular access to the rear of properties served by a street. Alleys shall not be designed to accommodate parking. Parking shall be provided on private property. Driveway connections to alleys shall be flared.
- E.** Industrial/Commercial streets are streets located in Industrial and/or Commercial areas. Industrial/ Commercial streets shall be the same as Collector streets.

Table 5-1: Town of Wellington Street Standards

Street Classification	Arterial	Collector		Residential Local	Alley
		Major	Minor		
Where Used	3,500 to 15,000 vehicles/day	3,500 to 5,000 vehicles/day	2,500 to 3,500 vehicles/day	less than 2,500 vehicles/day	access to rear of properties
Minimum Right-Of-Way	100	80	80	60	12 residential 20 commercial/ industrial
Minimum Street Width (Flowline to Flowline)	52	48	48	38	12 to 20
Utility Easement	15	9	9	9	
Design Speed/Posted Speed	50/30-45	40/30-35	40/25-30	30/25	15/15
Horizontal Alignment					
Minimum Centerline Radius	1200'	600'	600'	240'	-----
Minimum tangent between curves or intersections	200'	150'	100'	100'	-----
Minimum corner sight distance	500'	400'	300'	300'	-----
Minimum stopping sight distance	350'	275'	200'	200'	-----
Min. distance from center to center of Intersections	Signalized	2640'	N/A	N/A	-----
	Unsignalized	1320'	330'	250'	
Vertical Alignment					
Minimum super elevation	0.04 ft/ft	0.04 ft/ft	0.00 ft/ft	0.00 ft/ft	-----
Maximum super elevation	0.06 ft/ft	0.06 ft/ft	0.06 ft/ft	0.06 ft/ft	-----
Minimum grade	0.50%	0.50%	0.50%	0.50%	-----
Maximum grade	5.00%	8.00%	8.00%	8.00%	-----
Min. K-values Crest	80	60	60	30	-----
Sag	70	60	60	40	-----
General Parameters					
Designated Bike Lane	Y	Y	Y	N	-----
Bike Lane Width	8'	7'	5'	-----	-----
Travel Lane Width	12'	11'	11'	10'	-----
Parking Lane Width	None	None	8'	9'	-----
Min. Parkway Width	10'	8'	8'	None	-----
Min. Sidewalk Width	6'	5'	5'	4.5'	-----
Left Turn Lane Required	Y	Y	Y	None	-----
Left Turn Lane Width	12'	12'	12'	-----	-----
Driveway Access	N	N	N	Y	Y

Notes:

1. Corner sight distance is measured from a point on the minor road, parallel to the roadway, 15 feet from the edge of the major road pavement, and from an eye height of 3.5 feet on the minor road to the height of object and an eye height of 4.25 feet on the major road.
2. Stopping sight distance is measured from the driver's eye, 3.5 feet above the pavement to the top of an object 0.5 feet high on the pavement anywhere on the road.
3. Grades apply at the flowline of the gutters.
4. Major streets with full super elevation may have a minimum radius of 830 feet. Maximum change in cross slope is 1% in 25 feet.

PART 4 GENERAL DESIGN ELEMENTS

All streets shall be designed in accordance with design speeds specified for each street classification in the above-referenced figures and **Table 5-1**.

4.1 Alignment

Horizontal and vertical street alignments should conform to existing land layout plus the following criteria:

A. Horizontal Alignment

On Arterial and Major Collector roadways, curve radii and tangents shall be as large as possible using the minimums only where necessary. However, minimum radius curves shall be used on Local Residential and Minor Collector streets unless otherwise required. Angle point shall only be used when the delta angle is 59 minutes or less. All changes in direction shall be made using standard curves.

1. Horizontal Curve Radii. The minimum allowable centerline radii for horizontal curves shall be as designated in **Table 5-1**. Reverse and compound curves should be used only when a single radius curve will not work. For driver safety, compound curves shall have a ratio no greater than 1.5 where the value of the larger radius is divided by the smaller radius.
2. Minimum Tangent Length
 - a Intersection. Whenever a Minor street intersects a street of higher classification, a tangent length (measured from the nearest gutter flowline of the intersected street to the point of curvature in the intersecting street) shall be provided for a safe sight distance and safe traffic operation. The minimum required tangent lengths indicated in **Table 5-1** apply to the minor leg(s) only. The angle of departure shall not exceed 10 degrees for the length of tangent.
 - b Reverse Curves. The tangent between reverse curves shall be no less than the length shown in **Table 5-1**.
 - c Broken Back Curves. Two curves in the same direction (broken back curves) shall be separated by a tangent with a length of at least 2 times the minimum length shown in **Table 5-1**.
3. Consistent Radii. All curves along a street shall be designed with radii that are approximately equal. The purpose of this limitation is to provide consistency and minimize unexpected difficult or quick maneuvers for the driver.

4. Curves with Small Deflection Angles (10° or less). To reduce the appearance of kinks in the street, minimum lengths of curve shall be designed with minimum arc lengths as shown in **Table 5-2**.

Table 5-2 Centerline Arc Lengths	
Street Classification (ft.)	Minimum Centerline <u>Arc Length</u>
Arterial	400
Collector	300
Local, Residential	100

5. Horizontal Curves on Vertical Curves. For driver safety, horizontal curves shall not begin near the top of a crest vertical curve nor near the bottom of a sag vertical curve.
6. Transitions for Roadway Shifts or Lane Drops. Refer to requirements for redirect /approach and bay taper, **Figures 5-13 through 5-15**.
7. Coefficient of Friction. The coefficient of friction shall conform to the values in Figure III-1 of the **AASHTO “Green Book.”**
8. Off-Site Design Centerline, Flowlines and Cross Sections. To assure that future street improvements will meet these Standards the centerline, flowline, and cross sections of all streets, except cul-de-sacs, may be required to be continued for 500 feet beyond the proposed construction. The grade and ground lines of all Arterials shall be continued and additional 500 feet for a total of 1000 feet beyond the end of the proposed construction.
9. Joining Existing Improvements. Connection with existing streets shall be made to match the existing alignment grade of the existing improvements, in accordance with horizontal alignment criteria.

B. Vertical Alignment

1. Maximum and Minimum Grades for Streets. The maximum and minimum grades for specific street classifications are shown in to **Table 5-1**. The centerline grade in the bulb of a cul-de-sac shall not exceed 3 percent. The flowline grade in the bulb of a cul-de-sac shall be a minimum of 1 percent.
2. Minimum Flowline Grades. Minimum flowline grades for gutters shall be one-half (0.5) percent, except the bulb of cul-de-sacs where the minimum shall be one (1.0) percent.
3. Grade Breaks. No single point grade break shall exceed one-half (0.5) percent, except for the flow line in sag curves where the maximum grade

break is 1.0%. In curb returns, a grade break may be as great as 3.0% for extreme circumstances.

4. Requirements for Using Vertical Curves. Vertical curves are required for grade changes that exceed 1.0 percent. Both centerlines and the curb and gutter flowlines shall be designed with vertical curves to meet the requirements of **Table 5-1**. A series of grade breaks may be used in lieu of a specified vertical curve as long as the series of breaks meet the vertical curve criteria in these Standards for the design speed. K-values for design shall conform to **Table 5-1**. In sag curves on flow line, the minimum grade requirement shall override the slope within the vertical curve. Continuous changing of grades that create a roller coaster effect shall not be permitted.
 - a Minimum Length Crest and Sag. **Table 5-1** gives minimum length of crest and sag vertical curves for various algebraic differences in grade. Street designs shall meet or exceed these minimums
 - b Crest Curves. For crest curves, the street centerline, curb, and gutter shall be designed with vertical curves in accordance with minimum requirements shown on **Table 5-1**. K-values for design shall conform to **Table 5-1**.
 - c Sump Sag Curves. For sag curves the street centerline shall be designed with a vertical curve with minimum length as shown on **Table 5-1**. The minimum flowline grade on a sag curve shall be one-half (0.5) percent. Curb and gutter shall be constructed with no vertical curve in these areas.
5. Joining Existing Improvements. Connection with existing streets shall be made to match the existing grade of the existing improvements, in accordance with vertical alignment criteria. (Grade breaks shall not exceed allowable.)
6. Vertical Clearance. Vertical clearance above a roadway is a minimum of 13.5 feet.
7. Intersection Approach Grades. Intersection approach grades are discussed in **Part 1A, Intersections**.
8. Off-Site Continuance of Grade and Ground Lines. To assure that future street improvements will meet these Standards the grade and ground lines of all local and collector streets, except cul-de-sacs, shall be continued for 500 feet beyond the proposed construction. The grade and ground lines of all Arterials shall be continued 1000 feet beyond the end of the proposed construction

9. The intersection of any street with a major street shall be designed to the ultimate street grade of the major street (arterial or collector). The grading of the property adjacent to the major street shall meet these ultimate grades. The major street profile must be approved by the Town.
10. Show centerline profiles through intersections and crosspans to provide smooth riding transitions. All vertical curves shall be labeled with design speed, K Factor, length of curve (L), algebraic difference in grade in percent and finished elevations on twenty-five (25) foot stations.

C. Sight Distance

Sight distance is the distance necessary for a vehicle operator to perform expected functions and be able to do so without causing a hazard for the driver or other vehicle operators for the specific design speed of the street. Vehicles shall perform moves without causing other vehicles to slow from the average running speed. In no case shall the distance be less than the stopping sight distance. This includes visibility at intersections and driveways as well as around curves and roadside encroachments.

1. **Stopping Sight Distance.** Stopping sight distance is calculated according to the **AASHTO “Green Book,” Chapter III**. Object height is 6 inches above road surface and viewer’s height is 3.50 feet above road surface. Where an object off the pavement restricts sight distance, the minimum radius of curvature is determined by the stopping sight distance. In no case shall the stopping sight distance be less than as specified in **Table 5-1**. The sight distance design procedure shall assume a 6-foot high fence (as measured from actual finished grade) exists at all property lines except in the sight-distance easements that may be required to preserve the needed sight distance.
2. **Stopping Sight Distance on Horizontal Curves.** Stopping sight distance on horizontal curves is based upon lateral clearance from the inner edge of pavement to sight obstruction, for various radii of inner edge of pavement and design speeds. The position of the driver’s eye and the object sighted shall be assumed to be 6 ft. from the inner edge of pavement, with the sight distance being measured along this arc. Stopping sight distances are given in **Table 5-3**.

Table 5-3		
Stopping and Passing Sight Distance		
Design Speed (MPH)	Stopping Sight Distance (feet)	Passing Sight Distance (feet)

20	125	800
25	150	1000
30	200	1100
35	250	1300
40	275	1500

From AASHTO “Green Book” Table III-1, Table III-5 and Table VII-3
(For Intersection and Driveway Sight- Distance, see Figure 7-16.)

3. **Passing Sight Distance (Rural Applications Only).** Two-lane roads shall provide adequate passing zones. Required passing sight distance for given design speeds are given in **Table 5-3**. Passing zones are to be provided on 2 lane roads, which may be classified as Arterials and occasionally on Major Collectors.
4. **Corner Sight Distance.** The corner sight distance provides for vehicles to enter traffic and accelerate to the average running speed. Corner sight distance shall be measured as shown in **Figure 5-5**.
5. **Sight Distance Triangles and Easements.** All sight-distance easements must be shown on the street plan/profile plans. All sight distances must be within the public right-of-way or a sight distance easement. If the line of sight crosses onto private property, a “Sight Distance Easement” shall be dedicated to provide the required sight distance. The easement or right-of-way shall be dedicated to the Town; however, maintenance shall be noted on the final plat as the responsibility of a private entity such as the property owner or the home owners association.
6. **Sight Obstructions.** Any object within the sight distance easement more than 30 inches above the flowline elevation of the adjacent street shall constitute a sight obstruction, and shall be removed or lowered. Such objects include but are not limited to berms, buildings, and parked vehicles on private property, cut slopes, hedges, trees, bushes, utility cabinets or tall crops. Mailbox clusters must be installed a minimum of two (2) feet from back of walk and not cause any sight obstruction. Mailboxes must not pose a fixed object hazard for vehicles and pedestrians. Since parked vehicles are under the control of the Town, parked vehicles shall not be considered an obstruction for design purposes. The city may limit parking to protect visibility. The sight distance shall be measured to the centerline of the closest through-lane in both directions. In no case shall any permanent object encroach into the line-of-sight of any part of the sight-distance triangle. Street trees required by the Town are excepted from this requirement. Trees are permitted if pruned up to eight (8) feet.

4.2 Cross Slope

Cross slope on a pavement is provided to drain water from the street surface. The design of cross slope shall consider driver comfort and safety. Flowline elevation should be the same on both sides of the street, except at intersections where possible.

A. Minimum Cross Slope

A minimum cross slope on all streets shall be two (2.0) percent. Minimum cross slope on reconstruction overlay is one and one-half (1.5) percent.

B. Maximum Allowable Cross Slope

Maximum allowable cross slope on all new construction shall be three (3) percent. Maximum allowable Cross Slope on any reconstruction or overlays of existing roadways shall be four (4) percent.

C. Cross Slope for Street Modifications

When widening an existing street or adding turn lanes to an existing street, the resulting cross slope of the widened portion shall be within the limits stated above and the new Cross Slope shall be no less than the existing cross slope. However, if the Cross Slope of the existing street exceeds the Standards then new curb and gutter shall be designed such that the existing pavement, when overlaid, will result in a straight line cross slope grade that meets these Standards. Alternatively, the existing pavement may be removed and reprofiled to comply with these Standards.

D. Cross Slope for Cul-de-Sacs

Refer to **Figure 5-6** for cul-de-sac bulb cross slopes.

4.3 Superelevation on Horizontal Curves

The purpose of superelevating a roadway is to maintain the riding comfort on smaller than standard curves. Superelevation may only be used when other means of design will not work. The following criteria shall be followed.

A. Where Superelevation Is Permitted

Superelevation may be allowed for curves on Arterial and Major Collector streets in order to reduce the minimum centerline radius. In no case shall superelevation exceed six hundredth (0.06) foot per foot. As specified in **Table 5-1**, superelevation shall not be used to reduce minimum radii on Local or Minor Collector Street. Where super elevation is used show the following: rate of super elevation, profiles of the centerline and both flowlines, run out lengths, crown run out length, and point at which full super elevation is reached. Streets with full super elevation may have a minimum radius of eight

hundred thirty (830) feet. Maximum change in cross slope is one (1) in twenty (25) feet.

B. Run-Out

When superelevation is used, a minimum one hundred (100)-foot run-out shall be used entering and exiting the superelevated portion.

C. Drainage

Where the superelevation is used, the gutter shall always be an inflow type. The water must enter a storm sewer system or other acceptable outlet from the street rather than crossing the street in sheet flow or in crosspans.

4.4 Design Speed

Each roadway classification has a specific design speed. See **Table 5-1**.

4.5 Curb Return Radii

The required curb return radii are defined in **Table 5-5**, unless otherwise approved or required by the Town.

4.6 Misc.

Garage doors shall be set back from the back of curb a minimum of eight (8) feet where fences are placed with a setback equal to eight (8) feet or more, and a minimum of twenty (20) feet for fences with a setback of less than eight (8) feet.

PART 5 MEDIANS

If medians and corner islands are proposed they must be acceptable to the Town.

PART 6 NON-CONNECTIVE STREET ALIGNMENTS

6.1 Cul-de-Sacs

Cul-de-sacs shall be used only where necessary.

A. Permitted Locations

Cul-de-sacs are permitted only on Local Streets in conformance with **Figures 5-6**.

B. Maximum Length

The cul-de-sac shall have a maximum length of six hundred sixty (660) feet. If commercial sites or residences install fire sprinkler systems, the Local Entity may increase this length to one thousand (1,000) feet.

C. Minimum Parking

A minimum of one parking space must be provided for each residence. All parking areas outside of the Right-of-Way shall have the appropriate easements and shall be maintained by private entities.

6.2 Eyebrows

A. Permitted Locations

Eyebrows shall be permitted only on Local Streets that intersect Local Streets in conformance with **Figure 5-7**.

B. Temporary Dead-End Streets

Temporary dead-end streets will be permitted only on streets that have no direct access from adjoining property. Additionally, a temporary dead-end street shall be planned to extend into neighboring property during a later development phase or project. The road must be fully constructed to the property line.

1. **Signage.** Signage for temporary, dead-end Roadways shall be in accordance with the **MUTCD**.

C. Temporary Turnarounds

At locations where a street will be temporarily terminated with access provided from the street and the street is planned to be extended with future development, a temporary turnaround shall be constructed. The turnaround shall have a minimum radius of fifty (50) feet to the edge of the completed dead-end street. No curb and gutter is required on temporary turnarounds.

D. Temporary Turnaround Easements

All temporary turnarounds shall be constructed within an access easement. The easement may be vacated by the Town when the easement is no longer necessary. Application for vacation of the easement must be initiated and paid for by the Developer or property owner.

PART 7 DRAINAGE SYSTEMS

7.1 Drainage

Drainage system design shall be in accordance with Wellington's current storm drainage requirements. Drainage plans must be approved before final approval of street plans. Drainage shall not be a major function of a street.

7.2 Grading in Right-of-way

A. Slopes

The maximum slopes for all areas within the Right-of-Way or outside of the right of way that can affect the public improvements, shall be 4:1 unless designed with retaining walls. Any slopes proposed to exceed 4:1 must be proven to be stable and must be approved by the Town Engineer. In general, retaining walls are discouraged and not allowed within the right-of-way. The minimum slopes in non-roadway areas shall be two (2) percent unless otherwise allowed by the Town Engineer. All areas shall be seeded or stabilized in accordance with these Standards or the requirements of the Town, whichever is more conservative.

B. Off-site Fill Material

Any material from an offsite location to be used in rights-of-way or areas within the influence area of the right-of-way must be tested and discussed within the Soils Investigation Studies.

7.3 Sub drains

A. Controlling Groundwater

Sub drains used for the purpose of controlling groundwater on private property may be constructed within public right-of-way if certain criteria are met. The system shall be private and must be maintained by viable private parties and approved with an Encroachment Permit if applicable.

B. Protecting Right-of-way Improvements

Sub drains constructed for the purpose of protecting public right-of-way improvements may be installed only if other means are not possible. The town shall own and maintain these systems.

C. Design Criteria

All sub drains covered by these Standards shall be designed to meet the following criteria:

1. **Positive Outfall:** Demonstrate that sub drain has positive outfall for gravity drainage; prevent surcharging of sub drain.
2. **Adequate Engineering:** Demonstrate that the system has been designed in consideration of site-specific groundwater conditions, soil properties, topography, and layout of proposed development. Address maintenance aspects of recommended design.
3. **Sanitary Sewer Kept Dry (minimize infiltration):** Demonstrate that the sub drain system maintains adequate flow capacity under peak hydraulic loading rates to keep groundwater below the invert of the sanitary sewer.

4. No Offsite Transport: Show that the system will neither receive groundwater inflow from additional upstream developments, nor transfer collected groundwater to downstream developments.
5. Water Rights: The system shall be shown to create no injury to existing water rights or others on their property in the project vicinity.
6. Two (2) Year Monitoring after Construction: The system shall incorporate provisions to allow monitoring of groundwater levels to confirm that it is functioning as designed.
7. Design for Seasonal High Water: The system shall be designed in consideration of seasonal high groundwater levels anticipated at the project site.
8. Groundwater Barriers: The system shall be designed such that clay cutoff walls are provided at boundaries of the development to preclude hydraulic communication with offsite utility trenches either upstream or downstream.
9. Filter Fabric: The utility trench shall be lined with a filter fabric specifically selected in consideration of on-site soil conditions in order to minimize the invasion of fine soil particles into the bedding gravel.
10. Pipe Diameter: eight (8) inches minimum for mains; three (3) inches minimum for laterals (pipe diameter shall be different from the sewer lateral).

7.4 Sidewalk Culvert (Chases)

Storm water from concentrated points of discharge shall not be allowed to flow over sidewalks, but shall drain to the roadway by use of a sidewalk culvert or other methods approved by the Town Engineer. A sidewalk culvert shall not be located within a curb ramp, curb cut, or driveway. Sidewalk culverts shall only be allowed in special situations, on a case-by-case basis, as determined by the Town Engineer.

7.5 Crosspans

A. Basic Requirements

Crosspans for passing storm drainage flow across roadways shall be constructed in accordance with the **Figures 5-8 and 5-9**. The use of double crosspans shall not be encouraged.

1. Double crosspans may parallel collector or major streets to convey storm runoff across minor streets.

2. Double crosspans may be used at the intersection of Minor Street only when absolutely necessary to prevent flooding of one side of the street.
3. Crosspans shall not be constructed on curves and generally are not acceptable at non-stop intersections.

B. Prohibited on Arterial and Collector Streets

No crosspans are allowed to cross Arterial and Collector streets.

C. Minimum Grade

Minimum grade on crosspans at flowline of pan shall be six tenths (0.6) of a percent.

D. Crosspan Transitions

The following criteria shall be followed for crosspan approaches:

1. Design Speeds. Pavement transition from standard crown to crosspan shall be designed using the appropriate design speeds as given in **Table 5-1**.
2. Intersections. Transitions from standard crown to crosspan at intersections shall be designed in accordance with **Figure 5-10**. Details shall be prepared to show the elevations in the locations shown on **Figure 5-10**.
3. Pavement Material. In asphalt paved streets, approaches to crosspans shall be constructed with full depth asphalt wedges per **Figure 5-9**.

E. Monolithic Paving

If pavement is concrete, any drainage conveyance, such as crosspans, may be poured monolithically with the main line paving process.

7.6 Sidewalks, Curb and Gutter

A. Sidewalks

1. Typical Cross-Sections. Sidewalk shall be six (6) inches thick, minimum, Roadway typical sections that include sidewalks shall be as specified in this chapter. The typical cross-sections are summarized in **Figures 5-1 through 5-4**.

B. Curb and Gutter

See **Table 5-1 and Figures 5-1 through 5-4** for the type of curb and gutter to be used for the various street classifications.

1. Drive-Over Curbs. Drive-over combination curb, gutter, and walk is permitted on Local Roadways only. Refer to **Figure 5-12** for Drive-Over curb detail.
2. Vertical Curb and Gutter (Type II). The vertical curb or curb and gutter section shall be in accordance with **Figure 5-12**. All new streets shall be constructed using vertical curb and gutter except for the Residential Streets and Alleys where Drive-Over curb and gutter may be used.

7.7 Inlets

Inlets located in a sidewalk shall be integrated with sidewalks. The inlet access shall be flush with the sidewalk surface. No manholes, inlets, or other storm sewer facilities are allowed within curb ramps. Refer to the appropriate requirements for sizing of inlets. Inlets are not allowed in the curb return, but shall be located at or behind the tangent points of the curb returns.

7.8 Waterway Crossings

All waterway crossings beneath and/or within the public right-of-way shall be designed to minimize maintenance requirements. For irrigation structures, the minimization of silting within the structure must be addressed. The design shall maintain or increase the water velocity through the structure to minimize silting or provide other design elements to address this issue.

7.9 Rural Roadside Ditches

Any rural or interim roadway sections developed without curbs (and with roadside drainage ditches) must complete the ditch construction with the installation of sod or other approved erosion control blanket within the ditch area. The profile grade of the ditch shall be maintained at a minimum slope of one (1) percent and a maximum slope of five (5) percent. The side slopes of the ditches outside of the Right-of-Way shall be a minimum of 4:1 and meet any specific criteria of these standards and the Town.

Flatter slopes may be considered when a paved invert is designed for the ditch bottom.

A. Slope

The slope and capacity of any roadside ditches shall be maintained in any areas that driveways cross the ditch. Each site is required to provide a HDPE or concrete pipe, a minimum of fifteen (15) inches in diameter, calculated to meet capacity and strength requirements of the Town. The pipe shall be designed to have no less than twelve (12) inches of cover over the pipe. All portions of the driveway within the Right of Way shall be paved with concrete or asphalt.

B. Maintenance

All driveway improvements within the right-of-way including piping, ditches, curb and gutter, and sidewalk are the responsibility of the adjoining property owner. The Town will not provide maintenance of these items.

PART 8 EMERGENCY ACCESS REQUIREMENTS

Any emergency access not on public streets shall be provided in accordance with the Wellington Fire Marshall.

8.1 Slope

The slope of the fire lanes shall be a minimum of one-half (0.5) percent and a maximum of eight (8) percent.

8.2 Cross Slope

The Cross Slope of the fire lanes shall be a minimum of one (1.0) percent and a maximum of four (4.0) percent.

8.3 Lane Width

The lane width shall be a minimum of twenty (20) feet from the edge of the roadway to edge of the roadway and shall be in an access easement. The access easement shall have a minimum width of twenty (20) feet. The lane widths may be required to be increased through horizontal curves to accommodate fire truck passage.

8.4 Vertical Clearance

There shall be a minimum of thirteen and one-half (13.5) feet of vertical clearance over the entire fire lane.

8.5 Barricade

The fire lane may have an approved barricade, but it must be approved by the Wellington Fire Department.

8.6 Roadway Surface

The surface of the roadway must be a paved surface complying with Local Street pavement thickness requirements, unless approved otherwise by the Town Engineer.

8.7 Maintenance

All access roadways shall be maintained and kept clear for emergency use at all times.

8.8 HANDICAPPED PARKING

A. Number of Spaces

A proportion of spaces in any parking facility which serves an accessible building shall be reserved for handicapped parking according to **Table 5-4**.

Table 5-4 Parking Stall Requirements	
TOTAL PARKING STALLS	REQUIRED MINIMUM NUMBER OF ACCESSIBLE SPACES
1 to 25	1
26 to 50	2
51 to 75	3
76 to 100	4
Over 100	Number will be determined by the Town

B. Location

Accessible parking spaces shall be located closest to the nearest accessible principal entrance, and accessible to the accessible route of travel. Ramps must be located on the passenger side of the parking space and be free of obstructions to passage.

C. Dimension

The minimum dimensions of handicapped parking stalls shall be 13' x 19'. This includes the parking stall (8' x 19' minimum) with a five (5) foot wide (minimum) demarcated aisle.

D. Signing

1. When handicapped parking spaces are required, such stalls shall be signed. Sign materials shall conform to the "Manual on Uniform Traffic Control Devices". The sign shall be twelve (12) inches x eighteen (18) inches with green lettering on a white background. This sign should read "Reserved Parking" followed by a blue handicapped symbol and a green arrow indicating the stalls restricted to handicapped parking.
2. The sign shall be set directly facing or no more than forty-five (45) degrees from the line of travel of a vehicle entering the stall. These signs may be mounted on a post or may be mounted permanently on an adjacent

wall using anchor bolts. Such signs shall be placed at the center of the end stalls of each handicapped parking area and at every second stall between.

INTERSECTIONS

PART 9 GENERAL

Intersections shall be designed to provide for the safety of motorists, pedestrians, and bicyclists. This section is based on criteria from the Institute of Transportation Engineers Traffic Engineering Handbook and **AASHTO's A Policy on Geometric Design of Highways and Streets**.

9.1 Intersections as Conflict Locations

By their nature, intersections are conflict locations. Vehicles, pedestrians, and bicycles all cross paths. Each crossing is a conflict point. Intersections contain many conflict points.

A. Basic Intersection Design

The basic design of intersections includes the following objectives:

1. Minimize points of conflict;
2. Simplify areas of conflict;
3. Limit conflict frequency; and
4. Limit conflict severity.

These objectives can be achieved using the design elements presented below.

PART 10 INTERSECTION DESIGN CRITERIA

10.1 Location of Intersections

For intersection location criteria, refer to the current Master Street plan.

10.2 Lane Alignment

All lanes shall be in alignment through each intersection, with a maximum of a two (2) foot shift in a hardship situation only, subject to approval by the Town Engineer.

10.3 Angle of Intersection

Crossing roadways should intersect at ninety (90) degrees for a minimum distance of fifty (50) feet from the edge of the intersection whenever possible. In no case

shall they intersect at less than eighty (80) degrees or more than one hundred (100) degrees.

10.4 Horizontal Alignment and Vertical Profile

A. Horizontal

The horizontal alignment of streets through an intersection shall be designed in conformance with **Table 5-1**. Intersections may be placed on horizontal curves, provided that the tangent lengths given in **Table 5-1** are provided on the minor street and the required sight distance is met. "T" type intersections are not permitted on curves with a radius of less than two hundred fifty (250) feet.

B. Vertical

The street profile grade shall not exceed four (4) percent on the approach to the intersection, as measured along the centerline of the street for a minimum distance equal to the tangent length for the street classification. The profile grade within the intersection streets shall not exceed three (3) percent.

C. Prevailing Street Grade

The grade of the street with the higher classification shall prevail at intersections. The lesser street shall adapt to the grade of the Major Street. Grading of adjacent property and driveways shall adapt to the street grades. When roads are of equal classification, the Town Engineer shall determine which street grade prevails.

10.5 Exclusive Left & Right Turn Lanes

Refer to **Section 01300, Transportation Impact Study Guidelines**, for requirements on exclusive left & right turn lanes. Turn Lanes shall be provided on all arterial streets and other streets wherever turn lanes are specified as needed by an access plan, required by these Standards or warranted and approved by the Town Engineer.

A. Left Turn Lane Design Criteria

Left turn lanes shall be designed to provide the following functions:

1. A means for safe deceleration outside the high speed through lane.
2. A storage length long enough for left turning vehicles so that signal phasing can be optimized and intersection delay minimized.
3. A means of separating movements at unsignalized intersections to reduce left turn impacts on other flows. The design elements for a left turn lane are as shown in **Figure 5-13 and 5-14**. The elements are the approach

taper, bay taper, lengths of lanes, width of lanes, and departure taper. For bay taper and approach taper lengths, see **Figure 5-13** and **Figure 5-14**. The required left turn lane widths shall be as specified in **Table 5-1** or **Figures 5-1 to 5-4**.

B. Right Turn Lane Design Criteria

Right turn lanes shall be designed to accomplish the following functions:

1. Provide a means of safe deceleration outside the high speed through lane.
2. Provide a separate storage area for right turns to assist in the optimization of traffic signal phasing.
3. Provide a means of separating right turn movements at stop controlled intersections. The design elements, as shown in **Figure 5-15**, are the approach taper, bay taper, lengths of lanes, width of lanes, and departure taper.

10.6 Design Vehicles

As a minimum, intersections shall be designed to accommodate the following AASHTO design vehicles for the specified turns. The minimum allowable intersection turning radii are as follows in accordance with the **AASHTO A Policy on Geometric Design of Highways and Streets**.

A. SU-30 (Single Unit Truck)

All SU-30 vehicles must be able to turn easily from one street to the next and remain in the correct lane for each roadway. This shall be required for all roadways and alleys.

B. B-40 (Bus)

All B-40 vehicles may use more than one traffic lane to complete the turn when turning from the correct lane without crossing into opposing traffic lanes and without tracking onto the curb at corners. This shall apply to all streets.

C. WB-50 (Large Semitrailer)

All WB-50 vehicles may use more than one traffic lane to complete the turn without tracking onto the curb at corners. In addition, the vehicle must make the turn in one forward maneuver encroaching into opposing traffic lanes. This requirement shall apply to all Arterial/Arterial, Arterial/Collector, and Collector/Collector. For all other intersections, the vehicles may use the entire paved surface of the street to negotiate the turn. The vehicle may have to back up to complete the turn.

D. WB-67 (Large Semitrailer).

All modern roundabouts and arterial intersections containing raised medians and channelizing islands shall be designed to accommodate a WB-67 vehicle.

E. Other Vehicles.

For special circumstances other design vehicles may be required by the Town Engineer.

10.7 Curb Returns

A. Curb Return Radii

The corner radii shall meet the following requirements in **Table 5-5** unless otherwise approved or required by the Town Engineer.

Table 5-5			
Minimum Curb Return Radii -			
	Local	Collector	Arterial
High Volume Driveway & Alley	15'	20'	20'
Local Residential	20'	20'	30'
Collector	20'	30'	30'
Arterial	30'	30'	30'

For curb returns on a State Highway, **CDOT's** curb radii requirements shall supersede these Standards.

B. Curb Return Grades

The minimum desirable grade for flowlines around the curb return should be one (1) percent. The minimum allowable grade for flowlines around curb returns shall be one-half (0.5) percent.

10.8 TRAFFIC CONTROL DEVICES AND SIGNAGE.

A. It is the responsibility of the Developer to install all traffic control devices, signage, street name signs and pavement markings prior to the opening of roadways.

B. All signs, sign materials, and barricade warning lights shall conform to the standards set forth in the "Manual on Uniform Traffic Control Devices for Streets and Highways".

10.9 Access Ramps

Access (handicap) ramps shall be installed at all intersections and at certain mid-block locations for all new construction or reconstruction of curb and sidewalk.

Handicap ramps shall be shown at all curb returns and shall be grooved perpendicular to pedestrian traffic path to prevent slipping. See **Figure 5-16** for Access Ramps Detail.

10.10 Right-of-Way

A. Requirements

All intersection rights-of-way and utility easements shall be dedicated as shown in **Figure 5-17** to provide adequate Right-of-Way to include sidewalks, access ramps, and utilities. Additional Right-of-Way may be required at intersections to provide space for additional left or right turn lanes without reducing the widths of standard required facilities.

10.11 Intersection Sight Distance

Street intersections shall be designed so that adequate sight distance is provided along all streets. The required sight distance shall be determined by the design speed and grades of the street and the acceleration rate of an average vehicle as prescribed below. Intersection sight distance is measured from a point on the minor road, parallel to the roadway, fifteen (15) feet from the edge of the major road pavement and from an eye height of three and one-half (3.5) feet on the minor road to the height of object of four and one-quarter (4.25) feet on the major road.

A. Minimum Requirements

All designs must provide minimum safe stopping sight distance in accordance with **Part 1, Street Design and Technical Criteria**, and **AASHTO**. In addition, for all streets that intersect with Arterial and Collector streets, the sight distance must be large enough to allow a vehicle to enter the street and accelerate to the average running speed without interfering with the traffic flow on the Arterial or Collector street. The design sight distance values to be used are provided in **Figure 5-5**.

B. Landscaping and Hardscaping

No landscaping or hardscaping shall be permitted within a corner cut that will block the line of sight for pedestrian visibility, (not higher than twenty-four (24) inches).

10.12 Channelization

Channelization refers to physical or visual guides used to separate vehicles, bicycles and pedestrians into particular lanes.

A. Intent of Channelization

B. Channelization is intended to:

1. Prohibit undesirable or wrong way movements.
2. Define desirable vehicular paths.
3. Encourage safe vehicle speeds.
4. Separate points of conflict wherever possible.
5. Cause traffic streams to cross at right angles and merge at flat angles.
6. Facilitate high-priority traffic movements.
7. Facilitate traffic control scheme.
8. Remove decelerating, stopped, or slow vehicles from high-speed through-traffic streams.
9. Provide safe crossings for pedestrians/bicycles.
10. Provide safe refuge for pedestrians.

C. Specific Channelization Requirements

Channelization shall be required at locations where it is necessary for safety or to protect the operation of the major street. Examples include:

1. Providing exclusive turning lanes, with appropriate striping as shown in **Figures 5-20**.
2. Providing travel lanes, with widths as specified in the standard street cross sections. See **Figures 5-1** through **5-4**.

10.13 Roundabouts

If roundabouts are proposed they must be acceptable to the Town.

10.14 Bike Lanes at Intersections

See Figures 5-1 through 5-4.

10.15 Pedestrian Requirements

See **Figure 5-20** for crosswalk markings.

10.16 Drainage

See Part 7, Drainage Systems, concerning drainage.

* * * END OF SECTION * * *

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SECTION 01042

ROADWAY STRUCTURAL PAVEMENT DESIGN

PART 1 GENERAL

- 1.1** Major streets are to be constructed of full depth asphalt on compacted subgrade.
- 1.2** All other streets are to be constructed of asphaltic concrete pavement, aggregate base course material, and placed on compacted subgrade. The use of treated base and treated subgrade is acceptable. Design must be approved prior to approval of plans. The Town may require the use of full depth asphalt on compacted subgrade for Collectors, Commercial/Industrial street, and Residential streets in locations where traffic, utilities, type of construction, maintenance requirements, or time of construction make it more practical.
- 1.3** Compaction using the Texas Gyrotory method is not acceptable.

PART 2 SAMPLING AND TESTING

- 2.1** This section establishes the standards to be used for soil investigation, sampling and testing for pavement design. This work shall be performed by a registered professional engineer licensed in the State of Colorado and who specializes in this type of work.
- 2.2** A soils report is required. A sufficient number of soil samples shall be obtained and tested to adequately characterize each soil type encountered. Soil borings for the report shall be taken in the roadway with a distance not to exceed five hundred (500) feet in length between borings, with a minimum of three samples shall be obtained and tested for each soil investigation. In addition, each report shall include the following:
 - A.** Site location, description and soil classifications.
 - B.** Laboratory tests reports with evaluation.
 - C.** Soil and groundwater conditions.
 - D.** 'R' Value calculations
 - E.** Analysis of corrosive characteristics.
 - F.** Compaction requirements.
 - G.** Recommendations and discussion.
 - H.** Pavement design calculations, including structural numbers of each layer.

- I. The Town may require plasticity index and liquid limit if it feels it is necessary.

(Note: No mixing of separate soil samples for testing will be allowed.)

- 2.3 When investigating existing paved streets, the Town may require cores, deflection tests, or other means of non-destructive testing of the existing pavement and base structure to determine whether an overlay or reconstruction is required.
- 2.4 The poorest soils encountered shall be used for calculating the pavement thickness using the Hveem Stabilometer (R-value) method. If California Bearing Ratio values are determined, they shall be converted to R-values.
- 2.5 When expansive soils are encountered, the Contractor shall employ soil mitigation procedures in accordance with the approved soils report. Soil mitigation shall include one or more of the following procedures:
 - A. Moisture conditioning
 - B. Remove and replace
 - C. Fly ash addition
- 2.6 When embankment materials are to be placed within the prism of the roadway, the material used shall be observed and recommended for use by the Town Engineer or Geotechnical Engineer.

PART 3 DESIGN REQUIREMENTS.

- 3.1 The CDOT Highways Roadway Design Manual shall be used for pavement designs. Information contained in this section is intended to supplement and revise the CDOT Highways Roadway Design Manual.
- 3.2 Factors considered in the design are as follows:
 - A. A Serviceability Index of two (2.0) shall be used in the design for traffic volumes less than seven hundred fifty (750) A.D.T. An Index of two and one-half (2.5) shall be used for all major streets, commercial/industrial and collector streets.
- 3.3 The regional factor shall be determined using the summation of the following categories:

<u>Category</u>	<u>Factor</u>
Drainage (subsurface only)	
Very poor (high ground water)	1.00
Poor	0.50
Fair	0.25
Good	-0.25

- 3.4** Developers shall check with the Town to see if specific traffic volumes for the project are available. If specific volumes are not available, the following Equivalent Daily Load Applications (E.D.L.A.) for the street classification shall be used:

Design Traffic Numbers (E.D.L.A.)

MINIMUM DESIGN TRAFFIC NUMBERS (D.T.N.)

FOR USE IN PAVEMENT DESIGN

The minimum equivalent 18-kip Estimated Daily Load Applications (E.D.L.A.) for pavement design within the Town of Wellington on the basis of street classification and land use are as follows:

Street Classification	LAND USE		
	Residential (E.D.L.A.)	Commercial (E.D.L.A.)	Industrial (E.D.L.A.)
Arterial Major:			
2 lanes	125	155	200
4 lanes or greater	185	235	250
Collector:			
2 lanes	30	80	100
4 lanes or greater	30	120	150
Local:			
2 lanes	7	50	

EDLA's at intersections shall be a combination of the EDLA's of both intersecting streets.

3.5 STRENGTH COEFFICIENTS

Component		Limiting Test Criteria Coefficient
Hot Bituminous Pavement	$R_t^* = 95$	0.44
Hot Bituminous Pavement	$R_t = 90-94$	0.40
Hot Bituminous Pavement	$R_t = 87-89$	0.35
Hot Bituminous Pavement	$R_t = 84-86$	0.30
Hot Bituminous Pavement	$R_t = 83$	0.25
Road Mix Bit. Pavement		0.20
Existing Bituminous Pavement		0.20 to 0.44
Plant Mix Bit. Base	$R_t = 90$	0.44
Plant Mix Bit. Base	$R_t = 85-89$	0.30
Plant Mix Bit. Base	$R_t = 80-84$	0.25
Plant Mix Bit. Base	$R_t = 79$	0.22
Aggregate Base Course (A.B.C.)	"R" = 84	0.14
Aggregate Base Course (A.B.C.)	"R" = 78-8	0.12
Aggregate Base Course (A.B.C.)	"R" = 70-77	0.11
Aggregate Subbase Course	"R" = 50-60	0.10
Emulsified Asphalt Treated A.B.C.	$R_t = 95$	0.23
Emulsified Asphalt Treated A.B.C.	$R_t = 90-94$	0.20
Emulsified Asphalt Treated A.B.C.	$R_t = 84-89$	0.15
Emulsified Asphalt Treated A.B.C.	$R_t = 83$	0.12
Cement Treated A.B.C.	7 day Test = 650 psi	0.23
Cement Treated A.B.C.	7 day Test = 400-649 psi	0.20
Cement Treated A.B.C.	7 day Test = 399 psi	0.15
Hydrated Lime Treated A.B.C.	R" = 84	0.14
Hydrated Lime Treated A.B.C.	R" = 78-83	0.12
Fly Ash	160 psi min	0.10

Notes:

1. R_t = R value based on combination of stabilometer and cohesiometer tests.
2. Information is from Table 603.3, Roadway Design Manual, CDOT.
3. Material suppliers shall submit "R" values and " R_t " from an approved laboratory.
4. For purposes of design, strength coefficients for aggregate base course shall be eleven hundredths (0.11); for subbase one tenth (0.10); for plant mixed bituminous base course forty-four hundredths (0.44); and for plant mixed hot bituminous pavement forty-four hundredths (0.44).

PART 4 MINIMUM PAVEMENT REQUIREMENTS

- 4.1** The pavement design will be determined on a case-by-case basis depending on the findings of the submitted soils report. The minimum pavement section without any special subgrade treatment such as fly ash shall be as follows:

Street Classification	Asphaltic Concrete	Aggregate Base
Residential/Local	6"	6"
Minor Collector	6"	6"
Major Collector	6"	6"
Arterial	As approved by Town Engineer	

All shall be placed upon a minimum of twelve (12) inches scarified and compacted subgrade.

- 4.2** Flyash subgrade treatment shall be required with all new roads constructed in Town. A pavement design shall be submitted, which includes a flyash treatment of the subgrade by a Geotechnical Engineer licensed in the state of Colorado. Refer to Section 01040 part 3 for additional information.
- 4.3** Concrete pavement requires special permission of the Town of Wellington. The Town reserves the right to require concrete pavement on a case by case basis.

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SECTION 01043

TREATMENT FOR MATERIALS IN PLACE WITH CLASS "C" FLY ASH

PART 1 DESCRIPTION

- 1.1** This item shall consist of treating the subgrade, existing subbase or existing base by pulverization, adding Class "C" fly ash, mixing and compacting of the mixed material to the required density. This item applies to natural ground or embankment and shall be constructed as specified herein and in conformity with the typical sections, lines and grades as shown on the Drawings or as established by the Engineer.

PART 2 MATERIALS

2.1 Fly Ash

- A.** Fly ash shall meet ASTM Specification 618, Section 3.2, when sampled and tested in accordance with Sections 4, 6 and 8, unless otherwise shown on the plans. Fly ash shall be of the Class "C" designation containing a minimum of twenty-five (25) percent calcium carbonate.

2.2 Water

- A.** The water used in the stabilized mixture shall be clean, clear, and free of sewage, vegetable matter, oil, acid and alkali. Water known to be potable may be used without testing. All other sources shall be tested in accordance with AASHTO T- 26 and approved by the Materials Engineer.

PART 3 EQUIPMENT

- 3.1** The machinery, tools and equipment necessary for proper prosecution of the work shall be on the project site and approved by the Engineer prior to the beginning of construction operations.

- A.** All machinery, tools and equipment used shall be maintained in a satisfactory and workmanlike manner.

- 3.2** Fly ash shall be stored and handled in closed weatherproof containers until immediately before distribution on the road.

- A.** If storage bins are used, they shall be completely enclosed.

- B.** If fly ash is furnished in trucks, each truck shall have the weight of fly ash certified on public scales or the Contractor shall place a set of standard platform truck scales or hopper scales at a location approved by the Engineer.

PART 4 CONSTRUCTION METHODS

4.1 General

- A.** It is the primary purpose of this specification to secure a completed course of treated material which contains a uniform fly ash/soil mixture with no loose or segregated areas; has a uniform density and moisture content; is well bound for its full depth; and, has a smooth surface for placing subsequent courses. It shall be the responsibility of the Contractor to regulate the sequence of his work; to process a sufficient quantity of material to provide full depth as shown on plans; to use the proper amounts of fly ash; to maintain the work; and, to rework the courses as necessary to meet the above requirements.

4.2 Preparation of Subgrade

- A.** Before other construction operations are begun, the subgrade shall be graded and shaped to enable the fly ash treatment of materials in place, in conformance with the lines, grades, and thickness shown on the plans. Unsuitable soil or materials shall be removed and replaced with acceptable material.
- B.** The subgrade shall be firm and able to support, without displacement, the construction equipment and the compaction hereinafter specified. Soft or yielding subgrade shall be corrected and made stable by scarifying, adding fly ash, and compacting until it is of uniform stability.
- C.** If the Contractor elects to use a cutting and pulverizing machine that will remove the subgrade material accurately to the secondary grade and pulverize the material at the same time, he will not be required to expose the secondary grade nor windrow the material. However, the Contractor shall be required to roll the subgrade, as directed by the Engineer, before using the pulverizing machine and correct any soft areas that this rolling may reveal. This method will be permitted only where a machine is provided which will ensure that the material is cut uniformly to the proper depth and which has cutters that will plane the secondary grade to a smooth surface over the entire width of the cut. The machine shall be of such design that visible indication is given at all times that the machine is cutting to the proper depth.

4.3 Application

- A.** The fly ash shall be spread by an approved spreader at the rates shown on the plans or as directed by the Engineer. A motor grader shall not be used to spread the fly ash.
- B.** The fly ash shall be distributed at a uniform rate and in such manner as to reduce the scattering of fly ash by wind to a minimum. Fly ash shall not be

free from undulations and ruts, until other work is placed thereon or the work is accepted.

- C. The stabilized section shall be compacted to the extent necessary to provide the density specified below:

Description:	
For fly ash treated subgrade, existing subbase or existing base that will receive subsequent subbase or base courses	Not less than 95 percent maximum dry density (ASTM D-698)
For fly ash treated subbase or base that will receive surface course	Not less than 96 percent maximum dry density (ASTM D-698)

- D. In addition to the requirements specified for density, the full depth of the material shown on the plans shall be compacted to the extent necessary to remain firm and stable under construction equipment. After each section is completed, tests as necessary will be made by the Engineer. If the material fails to meet the density requirements, the Engineer may require it to be reworked as necessary to meet those requirements or require the contractor to change his construction methods to obtain required density on the next section. Throughout this entire operation the shape of the course shall be maintained by blading, and the surface, upon completion, shall be smooth and in conformity with the typical section shown on the plans and to the established lines and grades. Blading should be terminated within two (2) hours after blending of the fly ash. Should the material, due to any reason or cause, lose the required stability, density and finish before the next course is placed or the work is accepted, it shall be reprocessed, recompact and refinished at the sole expense of the Contractor. Reprocessing shall follow the same pattern as the initial stabilization, including the addition of fly ash.

4.6 Finishing, Curing and Preparation for Surfacing

- A. After the final layer or course of the treated subgrade, subbase or base has been compacted, it shall be brought to the required lines and grades in accordance with the typical sections.
- B. The resulting base surface shall be thoroughly rolled with a pneumatic tire roller and "clipped", "skinned" or "tight bladed" by a power grader to a depth of approximately fourteen (14) inch, removing all loosened stabilized material from the section. Recompaction of the loose material should not be attempted. The surface shall then be thoroughly compacted with the pneumatic roller, adding small increments of moisture as needed during rolling. If plus No. 4 aggregate is present in the mixture, one complete coverage of the section with the fat wheel roller shall be made immediately after the "clipping" operation. When directed by the Engineer, surface finishing methods may be varied from

this procedure provided a dense, uniform surface is produced. The moisture content of the surface material must be maintained within the specified range during all finishing operations. Surface compaction and finishing shall proceed in such a manner as to produce, in not more than two hours, a smooth, closely knit surface, free of cracks, ridges or loose material conforming to the crown, grade and line shown on the plans.

- C. After the fly ash treated course has been finished as specified herein, the surface shall be protected against rapid drying by either of the following curing methods for a period of not less than three (3) days or until the surface or subsequent courses are placed:
1. Maintain in a thorough and continuously moist condition by sprinkling.
 2. Apply a two (2) inch layer of earth on the completed course and maintain in a moist condition.
 3. Apply an asphalt membrane to the treated course, immediately after same is completed. The quantity and type of asphalt approved for use by the Engineer shall be sufficient to completely cover and seal the total surface of the base between crown lines and all voids. If the Contractor elects to use this method, it shall be the responsibility of the Contractor to protect the asphalt membrane from being picked up by traffic by either sanding or dusting the surface of same. The asphalt membrane may remain in place when the proposed surface or other base courses are placed. Asphaltic emulsions are not acceptable for the asphaltic membrane.

*** END OF SECTION***

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SECTION 02235

AGGREGATE BASE COURSE

PART 1 GENERAL

1.1 DESCRIPTION

- A.** Aggregate base course consists of one or more courses of crushed aggregate on prepared subgrade.
- B.** Applicable Publications
 - 1. The term "State Specifications" in this section refers to Colorado Department of Transportation, Division of Highways, "Standard Specifications for Road and Bridge Construction". Sections 100 through 109 and measurement and payment provisions shall not apply.

1.2 SUBMITTALS

- A.** Submit test results for each source of material
 - 1. Provide for the following:
 - a. Gradation
 - b. Los Angeles wear test
 - c. Aggregate quality
 - d. Liquid limits
 - e. Plasticity index
 - 2. Perform Soil Compaction Tests. ASTM D698 or AASHTO T99 - Standard Method of Test for Moisture Density Relations of Soils Using a 5.5 lb. Rammer and a 12 inch drop.
 - a. Use method A, B, C, or D, as appropriate, based on soil condition and judgment of the testing laboratory.
 - b. Sample tests will be representative of materials to be placed.
 - c. Determine and provide maximum density curve for each type of material encountered or utilized.

- d. Include Atterberg Limits, gradation and specific gravity.
3. Provide a density test of a typical sample.
4. Test results will be basis for field quality control.

1.3 JOB CONDITIONS

A. Drainage and Groundwater.

1. Maintain excavations free from water during construction.
2. Remove water encountered during construction to the extent necessary to provide a firm subgrade and remove standing water
3. Divert surface runoff or use other means necessary to accomplish the above.

B. Weather.

1. Do not construct aggregate base course during freezing weather.
2. Do not place on frozen surfaces.
3. Do not place frozen materials, snow or ice in aggregate base course.
4. Do not deposit, tamp, roll or otherwise mechanically compact in water.

C. Scarify surface, reshape, and compact to required density, completed or partially completed areas of work disturbed by subsequent construction operations or by adverse weather.

PART 2 PRODUCTS

2.1 AGGREGATE

- A.** Crushed stone or crushed gravel conforming to Section 703.03 of "State Specifications".
- B.** Gradation: Class 6 of Section 703.03 of "State Specifications" with an "R" value between 70 and 77.

PART 3 EXECUTION

3.1 SUBGRADE

- A.** Scarify to a depth of six (6) inches and compact. Not required if existing subgrade has been recycled.

- B.** Remove exposed cobbles, stones or boulders greater than six (6) inches in size that create an irregular surface at subgrade.
- C.** Compact and consolidate subgrades such that they are free from mud and sufficiently stable to remain firm, dense and intact.
- D.** Level and roll subgrade so that aggregate base course will be compact and bond well with the subgrade.
- E.** Proof roll subgrade prior to placement of aggregate base course to verify the stability of subgrade. Correct areas that are not stable

3.2 INSTALLATION

- A.** Maximum compacted thickness of one (1) layer not to exceed six (6) inches.
- B.** Proof roll aggregate base course to verify the stability. Correct areas that are not stable.

3.3 FIELD QUALITY CONTROL

A. Field Compaction Control.

1. One (1) compaction test shall be performed for each two thousand five hundred (2500) square yards of aggregate placed at locations indicated by Town.
 - a. ASTM D2922 (AASHTO T238) - tests for Density of Soil and Soil-Aggregate In-Place by Nuclear Methods.
 - b. ASTM D1556 (AASHTO T191) - tests for Density for Soil In Place by the Sand Cone Method.
 - c. ASTM D2167 (AASHTO T205) - tests for Density of Soil In Place by Rubber-Balloon Method.
2. Compaction shall be to the following minimum densities, reference ASTM D698 or AASHTO T99 unless otherwise indicated:
 - a. Subgrade: 95%
 - b. Aggregate base course: 95%
3. Moisture Content.
 - a. All compacted backfill shall be within 2% (+) of the optimum moisture content of the soil as determined by ASTM D698.

- b. Water shall be added to the material, or the material shall be harrowed, disced, bladed, or otherwise worked to insure uniform moisture content, as specified.

4. Reference also Table 5.6 of Section 02513 for Material Testing

B. Thickness: In-place compacted thickness will not be acceptable if exceeding following allowable variation from required thickness:

- 1. Aggregate Base Course: No limit on greater thickness, but no more than twenty-five hundredths (0.25) of an inch less than the thickness specified.

C. Surface Smoothness: Test finished surface of aggregate base course for smoothness, using ten foot straightedge applied parallel with, and at right angles to centerline of paved area. Surfaces will not be acceptable if exceeding following tolerances for smoothness:

- 1. Aggregate base course: twenty-five hundredths (0.25) of an inch.

* * * END OF SECTION * * *

SECTION 02513

BITUMINOUS PAVING

PART 1 GENERAL

1.1 DESCRIPTION

- A.** All materials and construction shall be done in conformance with the Colorado Department of Transportation's "Standard Specifications for Road and Bridge Construction". Requirements contained herein are intended to supplement and be in addition to the Colorado Department of Transportation's "Standard Specifications for Road and Bridge Construction". "CDOT" and "State Specifications" as used in these specifications refers to the Colorado Department of Transportation's "Standard Specifications for Road and Bridge Construction".
1. Sections 100 through 109 and measurement and payment provisions shall not apply.
 2. These specifications shall take precedence over conflicting requirements in the CDOT standard specifications.
 3. Reference to the "Division" shall be understood to refer to the Town and its authorized personnel.
- B.** Patching shall use hot bituminous pavement meeting the requirements of this section. Patching shall be the full depth of the existing bituminous pavement in place.

1.2 QUALITY ASSURANCE

A. Tolerances

1. Bituminous concrete job mix formula tolerances shall be as required in Section 401.02 of "State Specifications" except that the bitumen content shall be plus or minus three tenths (± 0.3) of a percent.

1.3 SUBMITTALS

A. Material Certificates:

1. Provide copies of material certificates signed by material producer and Contractor, certifying each material item complies with, or exceeds, specified requirements.

- a Provide test reports on aggregate sieve analysis, wear abrasion and other characteristics made on representative samples of the aggregate.
- b Provide test reports for asphalt cements including viscosity and viscosity of the blended asphalt cements.

B. Mix Design:

1. Submit job mix design and supporting mix design graphs for each separate mix to be used on the project.

1.4 JOB CONDITIONS

A. Weather Limitations:

1. Conform to Subsection 401.07 of "State Specifications".

PART 2 PRODUCTS

2.1 MATERIALS

A. Aggregates:

1. Bituminous Paving: Crushed stone, crushed gravel, crushed slag, and sharp-edged natural sand, Subsection 703.04. Use Grade S or SG for lower lifts and patches, Grade S or SX for surface course and overlays. Mix design shall be approved by Town Engineer prior to construction
2. Mineral Filler: Limestone dust, Portland Cement or other inert material complying with ASTM D242 or AASHTO M17 and Subsection 703.06, "State Specifications".

B. Bituminous Materials:

1. Asphalt Cement: Shall be unmodified Performance Grade (PG) type as approved by Town Engineer.
2. Tack Coat: Emulsified asphalt, AASHTO M140 or M208 and Subsection 702.04, "State Specifications".

C. Other Materials:

1. Marking Paint: Comply with requirements of Subsection 708.05, "State Specifications".

PART 3 EXECUTION

3.1 INSPECTION

- A.** Before starting paving, ascertain utility lines, piping, general grading and heavy trucking are complete so such operations will not damage paving work.

3.2 MANHOLE FRAMES AND VALVE BOX ADJUSTMENT

- A.** Prior to placing the pavement, adjust manhole frames and water valve boxes to one quarter (1/4) inch below final grade.
- B.** Immediately remove foreign matter which is introduced into manholes, valve and risers to provide free access to the facilities.
- C.** Manholes and valve boxes shall be straight and properly aligned.
 - 1. Valve boxes shall be inspected by placing a valve key on the operating nut to assure a proper alignment.

3.3 PREPARATION

- A.** Tack Coat:
 - 1. Apply to contact surfaces of previously constructed asphalt layers or Portland Cement concrete and surfaces abutting or projecting into asphalt concrete pavement.
 - 2. Distribute at rate of one tenth (0.10) gallons per square yard of surface or as otherwise directed.
 - 3. Allow to dry until tacky to touch prior to paving.

3.4 PLACING BITUMINOUS MIX

- A.** Mixing:
 - 1. Comply with Section 401.15 of the "State Specifications."
- B.** Placing
 - 1. Deliver job mix with temperature above two hundred and fifty (250) degrees Fahrenheit.
 - 2. Place inaccessible and small areas by hand.
 - 3. Place in lifts in accordance with the approved mix design and recommendations of approved soils report.

4. Paver Placing: Place in strips not less than twelve (12) feet wide. After first strip placed and rolled, place succeeding strips and extend screed to overlap previous strips by not less than six (6) inches.
5. Joints: Make joints between old and new pavements, or between successive days' work, to ensure continuous bond between adjoining work. Construct joints to have same texture, density, and smoothness as other sections of asphalt concrete course. Clean contact surfaces and apply tack coat.

3.5 ROLLING

- A. Begin rolling when mixture will bear roller weight without excessive displacement.
- B. Compact mixture with hot hand tampers or vibrating plate compactors in areas inaccessible to rollers.
- C. Breakdown Rolling: Accomplish breakdown or initial rolling immediately following rolling of joints and outside edge. Check surface after breakdown rolling, and repair displaced areas by loosening and filling, if required, with hot material.
- D. Second Rolling: Follow breakdown rolling as soon as possible, while mixture is hot. Continue second rolling until mixture thoroughly compacted.
- E. Finish Rolling: Perform finish rolling while mixture is still warm enough for removal of roller marks. Continue rolling until all roller marks are eliminated and course has attained maximum density.
- F. Protection: After final rolling, do not permit vehicular traffic on pavement until pavement has cooled and attained maximum degree of hardness.

3.6 PATCHING

- A. In areas where the Town allows patching cut out, clean and fill with fresh, hot bituminous pavement. Place rubberized asphalt around patched area.
 1. Remove deficient areas for full depth of bituminous pavement for extent of failure or as marked in the field by Town.
 2. When patching trench excavations, remove and replace asphalt a minimum of eighteen (18) inches beyond the edges of disturbed base material.
 3. Cut sides vertically, perpendicular and parallel to direction of traffic.

4. If base course is not firm, compact to ninety-five (95) percent standard proctor.
5. Remove and dispose of spoiled material and clean the area thoroughly.
6. Apply tack coat to exposed surfaces and base course before placing new pavement.
7. Replace with full depth hot bituminous pavement in lifts not to exceed three (3) inches.
8. Compact in lifts to density below.
9. Place rubberized asphalt around patched area.

3.7 PAVEMENT MARKING

- A.** Comply with requirements of Section 627.06, "State Specifications".

3.8 FIELD QUALITY CONTROL

- A.** Surface Smoothness: Test finished surface of each asphalt cement or aggregate course for smoothness, using 10-ft straightedge applied parallel with, and at right angles to centerline of paved area. Surfaces will not be acceptable if wearing course surface exceeds one thousand eight hundred seventy-five ten-thousandths (0.1875) of an inch tolerance for smoothness. All humps or depressions exceeding the specified tolerance shall be corrected by removing defective work and replacing it with new material, or as directed.
- B.** Material testing for concrete, soils and road materials shall be conducted in accordance with Table 5.6.

Table 5.6

Material Testing

Soils	AASHTO	ASTM	Frequency
Sampling	T87	D420	
Soil Classification	M145	D3282 D2488/D2487	Per soil type encountered
Moisture-Density (Proctor)			Per soil type encountered
Standard	T99	D698	As specified in Geotechnical Report
Modified	T180	D1557	As specified in Geotechnical Report
Density and Moisture Content	T238 & T239	D2922 & D3017	"Right of Way"
-Grading			1/1000 cubic yards
-Embankment			1/500 lf/lane (min. of 1 per street) 1' vertical
-Subgrade			1/500 lf/lane (min. of 1 per street)
-Utility Trench			1/100 lf horizontal & per 1.5' vertical
-Main			2 per service (vertical)
-Services			
-Manhole/Fire Hydrants			1/2' vertical within 2' alternating directions (min. of 4)
Hot Mix Asphalt (HMA)			
Sampling	T168	D979	
Density			
-Nuclear	----	D2950	1/500 lane feet (min. of 1 per street) per lift
-Coring	T166	D2726	As required or directed
-Laboratory Theoretical	T209	D2041	As required or directed
Asphalt Content & Gradation		D5444 or C136 (Gradation)	1/500 tons
Solvent	T164	D2172	
Ignition Oven	T308	D6307	
Nuclear	T287	D4125	
Thickness		D3549	As required or directed
Aggregate Gradation	T27	D5444 or C136	As required or directed
Fractured Faces		D5821	As required or directed
Concrete			
Sampling	T141	C172	
Mold and Cure	T23	C31	
Transportation of Cylinders	T23	C31	
Physical Properties			1/75 cubic yards/One per day Min.
Slump	T119	C143	Refer to 23.4.1.1; 23.5.3,C and Table 23-2
Air Content	T152	C231	Refer to 23.4.1.1; 23.5.3,C and Table 23-3
Compressive Strength	T22	C39	Refer to 23.4.1.1; 23.5.3,C and Table 23-4
Obtaining Cores	T24	C42	As required or directed
Compressive Strength of Cores	T24	C42	As required or directed
Aggregate Base Course			
Gradation	T27	C136	Per source or as required or directed
Moisture-Density (Proctor)			Per source or as required or directed
Modified	T180	D1557	As specified in Geotechnical Report
Standard	T99	D698	As specified in Geotechnical Report
Density/ Moisture Content			1/1000 lf/Lane--Min. 1 per street

* * * END OF SECTION * * *

SECTION 02520

PORTLAND CEMENT CONCRETE PAVING

PART 1 GENERAL

1.1 DESCRIPTION

- A. This section covers all cast-in-place concrete including forms, reinforcing steel, finishing, curing and other appurtenants to be used in pavements.
- B. Reference Section 02528 for construction of sidewalks, driveways, crosspans, curbs and gutters. The concrete shall meet the requirements of this section.

1.2 QUALITY ASSURANCE

A. Mix Design

1. Compressive Strength: 4,000 psi at 28 days

- a Minimum number of cylinders passing above requirement shall be 90%.
- b Minimum strength of cylinder acceptable, 3,500 psi.

2. Cement Content: 6 bags per cubic yard (564 pounds), minimum.

3. Maximum permissible Water - cement ratio for air-entrained, absolute ratio by weight 0.50.

4. Slump: 4 inch maximum

5. Air Content: 6% \pm 2% for concrete

6. Substitution of fly ash for cement is not allowed.

- B. The minimum thickness for concrete pavement is six (6) inches thick. The minimum thickness for concrete parking lots is five (5) inches thick.
- C. The term "State Specifications" in this section refers to Colorado Department of Transportation, Division of Highways, "Standard Specifications for Road and Bridge Construction". Sections 100 through 109 and measurement and payment provisions shall not apply. Conflicts between these specifications and the State Specifications shall be determined in favor of these specifications.

1.3 SUBMITTALS

- A.** Submit for acceptance the proposed mix design before concrete is ordered. Submit shop drawings on admixture agents including time of set up for high early concrete admixture. Include two (2) sets of compression test cylinders, two (2) cylinders per set, shall be made for each proposed mix. Test one (1) set of two (2) cylinders at age seven (7) days and other set at twenty-eight (28) days. Submit 2 copies of certified test reports to Town.
- B.** A delivery (scale) ticket shall be prepared for each load of ready-mixed concrete. A copy of each ticket shall be retained for viewing by the Town. Delivery tickets for shall indicating the following:
1. Supplier's name and date
 2. Truck number
 3. Project number and location
 4. Cubic yards batched
 5. Mix design identification
 6. Type, brand, and amount of cement
 7. Brand and amount of all admixtures
 8. Weights of fine and coarse aggregates
 9. Moisture content of fine and coarse aggregates
 10. Gallons of batch water, including ice
 11. Time at which water was added.
 12. Elapsed time between when water was added and concrete load was in place.
 13. Gallons of supplemental water added.
 14. Name of individual authorizing supplemental water.
 15. Numerical sequence of delivery by indicating cumulative yardage delivered on each ticket.
 16. Outdoor temperature in shade.
- C.** Provide the following titles with blank space to record information.

1. Discharge time
2. Water-cement ratio
3. Air content
4. Slump
5. Revolutions

1.4 JOB CONDITIONS

A. Environmental Requirements

1. Do not place concrete during rain, sleet or snow unless adequate protection is provided.
2. Do not allow rain-water to increase the mixing water or damage the surface finish.

B. Cold Weather Paving

1. For paving operations in cold weather reference "State Specifications" section 412.15.

C. Cold Weather concreting for operations other than pavement, such as crosspans, etc. shall be as follows:

1. Concrete shall not be placed when stormy or inclement weather will prevent good workmanship.
2. If the mean daily temperature falls below forty (40 degrees) Fahrenheit, all concrete shall be protected from freezing for six (6) calendar days by the use of insulating blankets or other approved methods. Covering the concrete with polyethylene sheets without using heaters will not be permitted. All concrete which is frozen and/or exposed to freezing weather shall be removed and replaced.
3. Temperature of concrete when placed shall not be less than the following:

Air Temp (°F)	Minimum Concrete Temp. (°F)	
	Sections with least dimension	
	Under 12"	12" and Over
30 to 45	60	50
0 to 30	65	55
Below 0	70	60

4. When placed, heated concrete shall not be warmer than eighty (80) degrees Fahrenheit.
5. Prior to placing concrete, all ice, snow, surface and subsurface frost shall be removed, and the temperature of the surfaces to be in contact with the new concrete shall be raised above thirty-five (35) degrees Fahrenheit.
6. Heated enclosures shall be strong and windproof to insure adequate protection of corners, edges and thin sections.
7. Do not permit heating units to locally heat or dry the concrete.
8. Do not use combustion heaters during the first twenty-four (24) hours unless the concrete is protected from exposure to exhaust gases which contain carbon dioxide.

D. Hot Weather Concreting

1. Take precautions when the ambient air temperature is ninety (90) degrees Fahrenheit or above.
2. Temperature of concrete when placed shall not exceed eighty-five (85) degrees Fahrenheit.
3. Cool forms and reinforcing to a maximum of ninety (90) degrees Fahrenheit by spraying with water prior to placing concrete.
4. Do not use cement that has reached a temperature of one hundred seventy (170) degrees Fahrenheit or more.
5. Prevent plastic shrinkage cracking due to rapid evaporation of moisture.
6. Do not place concrete when the evaporation rate (actual or anticipated) equals or exceeds two-tenths (0.20) of a pound per square foot per hour, as determined by Figure 2.1.4 of ACI 305.
7. Approved set-retarding and water reducing admixtures may be used when ambient air temperature is ninety (90) degrees Fahrenheit or above to offset the accelerating effects of high temperature with the approval of the Town.

PART 2 PRODUCTS

2.1 CONCRETE MATERIALS

- A. Cement: ASTM C150, Type I or II.**

B. Aggregates:

1. Fine aggregate - ASTM C33.
2. Coarse aggregate - ASTM C33, #57 or #67. Coarse aggregate for concrete shall conform to the requirements of ASTM C 131 (Los Angeles Abrasion Test), except that the percent of wear shall not exceed forty-five (45). Coarse aggregate shall be fifty (50) to fifty-five (55) percent of the total aggregate.

C. Water: Free from objectionable quantities of silt organic matter, alkali, salts, and other impurities.

D. Air-entraining Agent: ASTM C260.

E. Admixtures.

1. All admixtures must be approved by the Town.
2. High early: ASTM C 494, types C/E or approved equal. Calcium chloride may be used as an accelerating agent only upon approval of the Town. When approved, calcium chloride shall not exceed one (1) percent by weight of the cement. The calcium chloride must be added in a solution form at mixing time.
3. Admixtures must be compatible.

F. Equipment, batching, and mixing.

1. Equipment: "State Specifications" section 412.07
2. Batching: "State Specifications" section 601.06
3. Mixing: "State Specifications" section 601.07

G. Curing Material

1. Burlap Cloth made from Jute or Kenaff: AASHTO M 182
2. Sheet Materials for Curing Concrete: ASTM C 171
3. Liquid Membrane-Forming Compounds for Curing Concrete (white-pigmented): ASTM C 309

2.2 REINFORCING MATERIALS, DOWELS AND SUPPORTS

A. Bars: ASTM A615 or A617, Grade 40 or 60.

B. Polypropylene Fibers.

C. Welded Wire Fabric: ASTM A185. Reinforcing mesh shall be six (6) inches x six (6) inches - W2.9 x W2.9 with a weight of at least forty-two (42) pounds per one hundred (100) square feet.

D. Fabricated Steel Bar or Rod Mats for Concrete Reinforcement - ASTM A 184.

E. Metal Supports

1. **Steel Spaces:** Metal chairs used to support longitudinal, tie and reinforcing bar shall be channel shaped, pressed out of sheet steel of not less than twelve (12) gauge (U.S. Std.) metal.
2. **Dowel Baskets:** Preformed, continuous dowel expansion joint material supports will be eighteen (18) gauge (U.S. Std.) metal or three (3) gauge wire chairs with ten (10) gauge tie wires or heavier spaced no further than eighteen (18) inches along the axis of the expansion joint.

F. Expansion Tubes

1. Metal dowel caps or tubes shall be manufactured from thirty-two (32) gauge sheet metal or heavier; shall not be less than five (5) inches in length, shall be indented to provide a limiting stop for the dowel bars, and shall provide unobstructed expansion space of not less than one (1) inch to permit movement of the dowel bar. The inside diameter shall be one-sixteenth (1/16th) inch larger than the diameter of the specified dowel bars and the closed end shall be water tight. Caps made from bituminous treated paper or other similar material shall not be used.

G. Metal shall be free from scale, rust, oil or any other coating that will reduce bond.

2.3 MISCELLANEOUS MATERIALS

A. Forms

1. Designed to produce hardened concrete having the shape, lines and dimensions shown on the Drawings.
2. "State Specifications" section 601.09

B. Form Oil

1. Light colored paraffin oil, or other non-staining material.

C. Joint material

1. Preformed expansion joint material: Expansion joint material shall be non-extruding and resilient bituminous types and shall conform to AASHTO M 213. The filler shall be furnished in a single piece for the depth and thickness required for the joint and shall be pre-punched for reinforcing and dowels.
2. Joint filler material: "State Specifications" section 705.01.

D. Pavement marking: epoxy pavement marking material, "State Specifications" Sections 627 and 713.16

PART 3 EXECUTION

3.1 SUBGRADE

- A.** Scarify to a depth of six (6) inches and compact.
- B.** Do not work on subgrade while ground is frozen or muddy.
- C.** Remove exposed cobbles, stones or boulders greater than six (6) inches in size that create an irregular surface at subgrade. Backfill resulting voids with Base Course material compacted to required density.
- D.** Carefully compact near structures and over pipe to avoid damage.
- E.** Compact and consolidate subgrades such that they are free from mud and sufficiently stable to remain firm, dense, and intact under the feet of the workmen.
 1. Finish stabilized subgrade to elevations shown on Drawings.
- F.** Level and roll subgrade so that surface materials will be compact and bond well with the first layer of the base course, backfill or embankment.
- G.** Moisten base foundation immediately prior to placing of concrete.

3.2 FIXTURE ADJUSTMENT

- A.** All manholes, storm inlets, valve boxes or other fixtures encountered within the area to be paved shall be adjusted to conform to the finished surface of the pavement to be built. Prior to the placement of the pavement, the outside of the fixtures shall be cleaned of loose, foreign material for the depth of the pavement. Manhole castings and valve boxes outside the area to be paved but within the street right-of-way shall be adjusted to conform to the cross section after construction.

B. All manholes and valve boxes shall be in proper alignment, grade and slope.

3.3 REINFORCING MATERIALS, DOWELS AND SUPPORTS

A. Polypropylene Fibers. Add to the concrete at a rate suggested by the fiber manufacturer with a minimum of one and one-half (1.5) pounds per cubic yard. The concrete shall be mixed per ASTM C-94 to ensure that the fibers are dispersed throughout the mix.

B. Accurately place and maintain in proper position while concrete is being placed and compacted.

C. The minimum allowable clear distance (cover) per ACI 318.

	Minimum Cover
Concrete Placed Against Soil	3"
Concrete Exposed to Air or Backfill	2"
All Other Concrete	1 ½"

3.4 CONCRETE PLACEMENT

A. Mixing and Transporting Ready-Mixed Concrete

1. The time elapsing from the time water is added to the mix (or cement comes in contact with aggregate) until the concrete is deposited in place at the site of the work shall not exceed the following:

- a Air temperature forty-five (45) degrees Fahrenheit to eighty (80) degrees Fahrenheit – ninety (90) minutes maximum
- b Air temperature over eighty (80) degrees Fahrenheit with a retarder added to the mix – ninety (90) minutes maximum.
- c Air temperature over eighty (80) degrees Fahrenheit without a retarder added to the mix – sixty (60) minutes maximum.

B. Conveying

- 1. Convey to the point of final deposit by methods which will prevent the separation or loss of ingredients.
- 2. During and immediately after placement, concrete shall be thoroughly compacted, worked around reinforcements and embedments, and worked into all corners of the forms.

C. Placement

1. Reference "State Specifications" section 412.10
2. All concrete shall be placed in accordance with ACI 304.
3. All construction debris and extraneous matter shall be removed from within the forms.
4. Stays, bracing and blocks, serving temporarily to hold the forms in correct shape and alignment, shall be removed as placing progresses.
5. All concrete shall be placed on clean damp surfaces, free from water, or upon properly consolidated fills.
6. Concrete shall not be placed with a free fall of greater than four (4) feet to prevent segregation.

3.5 FINISHING

- A.** Reference "State Specifications" section 412.12, "Tining and stationing" is not required.
 1. Remove course aggregates disturbed by the initial floating or which cause a surface irregularity and replace with mortar.

3.6 JOINTS

- A.** Joint type and pattern for streets and parking lots.
 1. Submit a construction joint pattern showing types of each joint for approval prior to paving operations.
 2. The types and pattern shall be based upon the Portland Cement Association publication "Concrete Streets: Typical Pavement Sections and Jointing Details".
 3. The sawcuts for contraction joints shall be constructed continuously and shall be one-fourth (1/4) the thickness of the slab.
 4. Transverse joint spacing shall not exceed twelve and one-half (12.5) feet for pavement and ten (10) feet for parking lots.
- B.** Expansion joint material shall be installed between new structures and existing concrete, around fire hydrants, poles, inlets, other fixed objects, and between the ends of sidewalk slabs and curbs. Expansion joint material shall be vertical and with the top edge flush with the finished surface. The joint shall be edged with a suitable edging tool.

- C. Joint Sealing: Material for filling all types of pavement joints shall be a hot-poured elastomeric-type sealant specifically manufactured for sealing joints in concrete. The material shall not crack or break its bond when exposed to a temperature of zero (0) degree Fahrenheit.

3.7 REPAIR OF DEFECTIVE CONCRETE & CONCRETE PATCHING

- A. Repair of defective concrete shall be in accordance with "State Specifications" Section 412.16
- B. Refer to Section 02528, Part 3.5 for patching or replacement.

3.8 CURING

- A. Protect finished concrete for a minimum of three (3) days after placement.
 - 1. Maintain a minimum temperature of fifty (50) degrees Fahrenheit during this three (3) day period.
 - 2. Allow concrete to cure for a minimum of twenty-four (24) hours after the concrete is placed.
- B. The normal procedure for curing concrete pavement shall be curing compound in accordance with the "State Specifications" section 412.14 and 412.15. However, with the approval of the Town, Contractor may use one of the following methods. The Town may require the use of insulation blankets in cold weather.
 - 1. Wet Burlap Curing - After completion of the finishing operations, the surface of the concrete shall be entirely covered with burlap mats. The mats used shall be in such length or width that as laid they will extend at least twice the thickness of the concrete beyond the edges of the slab or structure. They shall be placed so that the entire structure and all edges of the concrete, when forms are removed, are completely covered. This covering shall be placed as soon as the concrete has set sufficiently to prevent marring of the surface. After being placed, the mats shall be thoroughly saturated with water by spraying with a mist spray. The burlap shall be so placed and weighted down as to cause it to remain in intimate contact with the surface covered, and covering shall be maintained fully wetted and in position for seven (7) days after the concrete has been placed. If it becomes necessary to remove the burlap for any reason, the concrete shall not be exposed for a period of more than one-half (0.5) hour. This method of curing shall not be used when the outside air temperature is below thirty-two (32) degrees Fahrenheit unless heated enclosures are provided.

2. Plastic Sheet Curing - As soon after the completion of the finishing operation as the concrete has set sufficiently to prevent marring of the surface, the top surface and sides shall be entirely covered with plastic sheet materials. The plastic sheet as prepared for use shall have such dimensions that each unit as laid will extend beyond the edges of the concrete at least twice the thickness of the concrete. The units as used shall be lapped at least twelve (12) inches and the laps of plastic sheet shall be secured in such a manner that they do not open up or separate. The plastic shall be so placed and weighted as to cause it to remain in intimate contact with the surface covered during the entire curing period of seven (7) days.
3. Insulation Pad - Insulation pads or other thermal devices may be used to protect concrete in cold weather.

3.9 FIELD QUALITY CONTROL TESTS

- A. Contractor shall perform the following field related laboratory tests. They shall be performed in strict accordance with the listed ASTM Specifications:

Test	ASTM Specifications
Slump	C 143
Air Content	C 173
Test Cylinders	C 31 or C 513
Core Samples	C 42

B. Strength test.

1. Test cylinders shall be made in sets of four (4). One (1) cylinder shall be field cured and broken at seven (7) days.
2. Three (3) cylinders shall be laboratory cured and broken at twenty-eight (28) days. If twenty-eight (28) day cylinders do not meet the specified minimum compressive strength then a representative number (as determined by the Town Engineer) of concrete cores shall be taken from the structure to determine if the in place concrete meets the specified strength.
3. Collect the following minimum number of sets of samples for concrete strength test for each days placing:

Quantity	Number of Samples
50 cubic yards or less	two
50 to 100 cubic yards	three
100 cubic yards or more	four plus one sample for each additional 100 cubic yards

C. Sample marking.

1. Mark or tag each sample of compression test cylinders with date and time of day cylinders were made.
2. Identify location in Work where concrete represented by cylinders was placed.
3. Identify delivery truck or batch number, air content, and slump.

D. Submit two (2) copies of each test results required.

E. Surface smoothness test.

1. Surface smoothness tests shall be in accordance with the "State Specifications" section 412.17 using the ten (10) foot straightedge method.

F. Compact to subgrade to 95% density in accordance with ASTM D698.

3.10 TRAFFIC PROTECTION

- A.** Contractor is responsible to protect the concrete from traffic. Contractor shall recommend time when concrete may be opened to traffic. Opening to traffic, including the Contractor's vehicles, will not be permitted until the compressive strength of six (6) inch by twelve (12) inch cylinders, tested in conformity with ASTM C 39 is at least two thousand eight hundred (2800) pounds per square inch.
- B.** Opening to traffic shall not constitute a final acceptance of the pavement.

* * * END OF SECTION * * *

SECTION 02528
CONCRETE CURBS, GUTTERS, AND SIDEWALKS

PART 1 GENERAL

1.1 DESCRIPTION

- A. Description of Work: Construction of curbs, curbs with gutters, cross-pan sections, and sidewalks.
- B. Definitions:
 - 1. The term "State Specifications" in this section refers to Colorado Department of Transportation, Division of Highways, "Standard Specifications for Road and Bridge Construction". Sections 100 through 109 and measurement and payment provisions shall not apply.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Concrete, reinforcing, joint material, and curing agent shall conform to requirements of Section 02520 of these specifications.

PART 3 EXECUTION

3.1 SUBGRADE

- A. Scarify to a depth of six (6) inches and compact.
- B. Do not work on subgrade while ground is frozen or muddy.
- C. Remove exposed cobbles, stones or boulders greater than six (6) inches in size that create an irregular surface at subgrade. Backfill resulting voids with Base Course material compacted to required density.
- D. Carefully compact near structures and over pipe to avoid damage.
- E. Compact and consolidate subgrades such that they are free from mud and sufficiently stable to remain firm, dense, and intact under the feet of the workmen.
 - 1. Finish stabilized subgrade to elevations shown on Drawings.
- F. Level and roll subgrade so that surface materials will be compact and bond well with the first layer of the base course, backfill or embankment.

G. Moisten base foundation immediately prior to placing of concrete.

3.2 FORMING

- A. Forms shall be of wood or metal and be straight and of sufficient strength to resist springing, tipping, or other displacement during process of depositing and consolidating concrete.
- B. Forms shall be of full depth and shall be of such design as to permit secure fastening.
- C. Face boards if used, shall be so constructed and shaped that their lower edge conforms to lines and radii of structures.
- D. Use flexible or curved forms of proper radius for curves of one hundred (100) foot radius or less.
- E. Forms shall be cleaned and oiled before concrete is placed against them.

3.3 INSTALLATION

- A. Place on properly prepared subgrade.
- B. Consolidate and slip form concrete to required section or deposit it in forms to proper depths, consolidate, spade against forms, strike off, and finish to required section.
- C. Contractor may use machine for placing, forming, and consolidating curb. If machine is used, resulting curb and gutter shall be of such quality as to equal or exceed that produced by formed methods.
- D. Face forms, if used, may be removed for finishing curb face and fillets as soon as concrete will retain its shape. Do not remove back forms until concrete has been in place for at least six (6) hours.

3.4 JOINTS

- A. Traverse joints shall be located at intervals of ten (10) feet in curbs, gutters, and crosspans. For sidewalks tooled joints shall be at five (5) feet. Joints shall be continuous through all three elements. Joints shall be a minimum of one quarter (1/4) thickness of the concrete. Set joints at right angles to face, top, and flow line.
- B. Expansion joint material shall be installed between new structures and existing concrete, concrete pans, around fire hydrants, poles, inlets, other fixed objects, and between the ends of sidewalk slabs and curbs. Expansion

joint material shall be vertical and with the top edge flush with the finished surface. The joint shall be edged with a suitable edging tool.

C. Sealing Joints

1. Apply cold poured silicone sealant in accordance with manufacturer's instructions. Backer rod is not required.

3.5 CONCRETE REPLACEMENT

A. Remove, dispose of and restore to original or better condition concrete drives, curbs, gutters, sidewalks, and similar structures that get damaged during construction.

1. Remove concrete to neatly sawed edges or to existing smooth joint lines.
 - a Saw concrete to a minimum depth of two (2) inches.
 - b If saw cut would fall within three (3) feet of construction joint, cold joint, expansion joint, or edge, remove concrete to the joint.
2. Base course - construct in accordance with Section 304 of the Standard Specifications.
 - a Restore to same thickness as existing, but in no case less than three (3) inches.

B. Restore to existing alignment, dimensions and grades, or new alignment, dimensions and grades shown on Drawings.

C. Provide for a thirty (30) diameter lap if existing concrete that is removed contains reinforcing steel. New steel shall be of same diameter and of equal or better quality.

D. Restore all surface improvements to the same thickness as existing, but in no case less than the following:

1. Driveway – six (6) inches.
2. Gutter – six (6) inches measured at flowline.
3. Sidewalk –six (6) inches.

E. Tool outside edges of sections and joints with a one quarter (1/4) inch radius edging tool.

3.6 MANHOLE FRAMES AND VALVE BOXES

- A.** Prior to placing concrete adjust manhole frames and water valve boxes to final grade. Leave one quarter (1/4) inch below grade in areas of snowplowing.
- B.** Immediately remove foreign matter which is introduced into manholes, water valve boxes to provide free access to the facilities.
- C.** Valve boxes and manhole rings shall be straight and properly aligned.
 - 1. Valve boxes shall be inspected by placing a valve key on the operating nut to assure a proper alignment.

3.7 FINISHING

- A.** Trowel and brush face surface of curb and gutter.
- B.** Immediately after float finishing sidewalks and cross pans, slightly roughen the concrete surface by brooming in the direction perpendicular to the main traffic flow.
- C.** Round back edge of curbs, lip of gutter adjacent to pavement, and edges adjacent to joints with edger of one quarter (1/4) inch radius.
- D.** Fill honeycombed back formed areas with mortar. Replace concrete sections when honeycomb is exposed to view.

3.8 PROTECTION AND CURING

- A.** Reference Section 02520 of these specifications.

3.9 FIELD QUALITY CONTROL

- A.** Compact to accepted densities submitted with the mix design. The following are minimum densities in accordance with ASTM D698:
 - 1. Subgrade: 95%
 - 2. Base Course: 95%
- B.** The Work shall be in accordance with the following tolerances:
 - 1. The work shall be performed in a manner which results in the item being constructed true to line and grade, uniform in appearance, and structurally sound.

2. Items found with unsightly bulges, ridges, low spots, or other defects shall be removed and replaced at the Contractor's expense if the Town or Town Engineer considers them to be irreparable.
3. When checked with a ten foot (10') straightedge, grade shall not deviate by more than one-quarter inch (1/4") and alignment shall not vary by more than one-half inch (1/2").
4. Final elevation shall not depart from plan elevation by more than one-half inch (1/2").

* * * END OF SECTION * * *

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**DIVISION 6 –
IRRIGATION**

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SECTION 01050

IRRIGATION SYSTEMS

PART 1 GENERAL

1.1 INTRODUCTION

- A.** The purpose of this section is to provide design criteria and materials specifications for irrigation systems acceptable to the Town of Wellington. All system designs shall be in accordance with the requirements of the Town of Wellington Standard Design Criteria and Standard Construction Requirements and applicable national codes. The designer shall be responsible for compliance with these design standards in preparation of studies, construction drawings, and specifications.
- B.** Irrigation system(s) shall be classified into one of the following types:
1. Public System – owned, operated, maintained by the Town of Wellington and water supplied by the Town’s potable distribution system.
 2. Homeowner System – owned, operated, and maintained by the Homeowner. The water is supplied by the Town and the system is connected to the Homeowners side of the meter. Use of an approved backflow preventer is required. See PART 2 for approved back flow preventers.
 3. Private System - owned, operated and maintained by the Homeowners Association (HOA). Irrigation water is supplied by a community shared well system. In the case of a commercial/industrial property, the system is owned and managed by the property owner using private water rights. This type of system is considered non-potable.
- C.** Cross-Connections: Private System non-potable irrigation service shall not connect with any building or structure water system, which in turn connects to the Town’s potable water system. Cross-connections are also prohibited with any other consumptive-use water service.

1.2 DESIGN REQUIREMENTS

- A.** Use principles of Xeriscape in the design of the irrigation system. Some design considerations include: shrub and perennial beds should be zoned separately from turf areas; sloped areas are to have separate zoning for heads at the higher elevations from those at the lower elevation. Areas with different exposures should be zoned separately.

- B. Check valves-in-head shall be used for all areas adjacent to walkways, at the bottom of berms and adjacent to ponds.
- C. Provide for fittings to winterize the system at the end of each growing season by evacuating water from each system with compressed air. The winterization assembly will be located immediately outside of the pump enclosure on the Z pipe assembly. Include on construction drawings in a text box the specific step-by-step instructions for winterization.
- D. Provide quick coupling valves for incidental watering. Provide isolation gate valves to shut down portions of the irrigation system for maintenance operations.
- E. Irrigate tree plantings in dry land grass areas with bubblers.
- F. PVC Sleeves under pavement: PVC Schedule 40 sleeves for new pipe and control wiring shall be provided under all new roads.
- G. The depth of cover for nonpotable water mains below the final surface grade shall be between four (4) feet and six (6) feet. Under no condition shall the main have less than four (4) feet of cover below the final surface grade. The irrigation mains should be designed and constructed to cross under the potable water system with a minimum vertical separation of eighteen (18) inches.

1.3 SYSTEM REQUIREMENTS

- A. Provide the following design flow specifications in the format listed below. Design system to irrigate a given area at eighty (80) percent operational efficiency during peak season (June, July, and August) at forty-five (45) psi in eight (8) hours. Present these data in tabular format on the Drawings; include relevant data for each zone.

	UNITS	VALUE
Operational Efficiency	%	#
Peak Season Requirements	in/day	#
Area of Irrigated Turf	Sq. ft.	#
Total Area of System Coverage	acres	#
Total Daily Application	Inches	#
Total Daily Application	Acre ft.	#
Irrigation Flow Requirements [8 Hour irrigation window]	gpm	#

- B. Piping shall be looped and extended to next property line. “Transmission Mains” are defined as water mains that are ten inches (10”) and larger. “Distribution Mains” are defined as water mains that are two inches (2”) to eight inches (8”)...

- C. All transmission mains must have blowoff assemblies constructed at the low points of the line. Air relief valves will be installed at the high points as the terrain warrants.
- D. Valves used in non-potable water distribution shall be resilient seated gate valves conforming to AWWA C509 Standards. Valves shall be provided in the distribution system so that no single accident, break or repair will necessitate shutting down a length of pipe greater than five hundred (500) feet. Valves on arterial feeders (“Distribution Mains”) may be spaced not greater than one thousand (1000) feet if there are no branches to transmission or distribution mains.
- E. All buried line valves shall be provided with a valve box. Valve boxes shall be Cast Iron, two-piece box with round base and a five and one quarter (5-1/4) inch screw-type shaft suitable for depth of cover as required. Lids are to be painted purple and printed “Non-potable Water” or “Irrigation Water”.
- F. Landscape sprinkler systems:
 - 1. Underground sprinkler systems shall be designed in conformance with these specifications and shall receive approval by application permit prior to the start of construction.
 - 2. Irrigation services, serving separate properties, shall be metered individually.
 - 3. No irrigation system shall have designed within it a surface or subsurface faucet, hydrant, and/or any device to remove non-potable water from the system except by the sprinkler head.

1.4 SYSTEM LAYOUT: (TYPICAL)

- A. Location: Irrigation mains shall be typically located ten (10) feet either side of the potable water main. If the Town determines it is not feasible for an installation to be made in a dedicated street, the installation shall be made in a dedicated easement or right-of-way. Right angle crossings of public streets shall be subject to Town approval as to methods of crossing. In public streets, the non-potable water line shall be located a minimum of three (3) feet from the edge of the gutter pan.
- B. Restoration: No landscaping greater than three (3) feet tall (mature growth) or permanent structures may be placed in the easement/right-of-ways. For irrigation mains that are not located in public right-of-ways, surface restoration of landscaping or pavement is the responsibility of the property owner when the Town performs repairs or other maintenance on that line. Locate valves at property lines; avoid placing valves in concrete gutter pans.

C. Phasing: Irrigation mains serving one (1) lot shall be extended all the way across the frontage for future service. Irrigation main phasing if proposed must be shown on the overall utility plan and shall maintain design integrity within the overall system. A valve and blow-off shall be located at the end of each phase for testing and connection to future mains.

D. Easements

1. For public irrigation mains not located in a dedicated street, the easement shall be dedicated at a width of twenty feet (20') and shall be for the exclusive use of Town of Wellington water mains.
2. For combined easement with water or combined with sewer the total width shall be thirty feet (30') for both utilities.
3. Service lines are generally described as from the irrigation main to the property line or easement line. The property owner's responsibility is from the property line to the service connection.

E. Water Services

1. Each resident/customer shall be served by a separate service line and meter. No pressure booster shall be allowed on individual residential systems. Services shall be PVC C900 Class 150. All piping, connections and valve boxes shall be properly marked as described in PART 2 Products.
2. There shall be no physical connection to any potable water service line, inside or outside the property.
3. Service lines may not be installed in trenches with other utilities. A service line shall be separated from other conduits a minimum of ten feet (10') horizontally.
4. Service line connections to the main shall be shown on the drawings and labeled with the appropriate water line stationing.

1.5 REVIEW AND ACCEPTANCE OF DRAWINGS

- A. The Town reserves the right to review and comment on all irrigation system designs.

1.6 WARRANTIES

- A. The Contractor shall warrant the irrigation system for two (2) years following construction acceptance by the Town.

1.7 OPERATIONS AND MAINTENANCE DOCUMENTS

- A.** For as-built document requirements refer to Section 01720, Project Record Documents. The Contractor is also required to compile an Operations and Maintenance Manual, which will include any pertinent manufacturer's data and maintenance information for all mechanical devices installed in the system including pumps, valves and controls.

PART 2 PRODUCTS

2.1 GENERAL

- A.** All non-potable water piping, valves, outlets and fixtures and other appurtenances shall be color coded in conformance with the National Industrial Color Code.
- B.** All non-potable water controllers, valves, outlets, etc. shall be tagged or signed with the following words: "NON-POTABLE WATER – DO NOT DRINK".
- C.** Public areas including entrances to parks, medians and planters which are irrigated with non-potable water should be clearly signed "NON-POTABLE WATER – DO NOT DRINK"

2.2 BACKFLOW PREVENTION

A. General

1. Water service lines, inside or outside of any property or building, shall have no physical connection with any pipes, pumps, hydrants, or tanks that could draw or discharge any unsafe or contaminated water (including steam condensation or cooling water) into the water system.
 2. At a minimum all water taps one-and-a-half inch (1-1/2") and larger shall be fitted with a Town approved backflow prevention assembly. All taps must be fitted with an approved backflow prevention assembly in any case where a cross connection potential exists. In addition, all commercial taps where a routine annual inspection of the plumbing system is not performed shall be fitted with an appropriate back flow prevention assembly. All assemblies shall be installed according to the Colorado Cross Connection Control Manual, latest edition, tested upon installation, and re-tested every year thereafter.
- B.** Blowoffs and drain valves should be painted purple and appropriately labeled "NON-POTABLE WATER – DO NOT DRINK".

C. Reference the Uniform Plumbing Code, Latest Edition for additional information regarding general requirements, heat exchangers, protection from lawn sprinklers and irrigation systems, and protection from fire systems.

D. Acceptable Backflow Prevention Assemblies

1. No person shall install any water operated equipment or mechanism, or use any water treating chemical or substance, if it is found that such equipment, mechanism, chemical or substance may cause pollution or contamination of the domestic water supply. Such equipment or mechanism may be permitted only when equipped with an approved backflow prevention device or assembly.
2. All “Home Owner” irrigation connections one (1) inch and smaller shall be equipped with listed atmospheric breakers properly installed on the discharge side of each of the last shutoff valves. Where atmospheric breakers cannot be installed because of piping elevation or valves, other listed backflow preventers shall be installed in accordance with their requirements as set forth in the Uniform Plumbing Code.
3. Connections to the irrigation system larger than one (1) inch shall be equipped with an approved reduced pressure principle backflow preventer.
4. Reference Section 603.0, Cross Connection Control, of the Uniform Plumbing Code for additional backflow prevention information and requirements.

2.3 PVC PIPE AND FITTINGS

- A. PVC pipe shall be Class 150 belled end pipe manufactured from virgin polyvinyl chloride compound in accord with AWWA C900, AWWA C905 or ASTM D 2241 and ASTM D 1784, cell classification 12454-B, Type 1, Grade 1.
- B. Fittings shall be standard weight, Schedule 40, injection molded PVC. Comply with ASTM D 1784 and D 2466, cell classification 12454-B.
- C. Thrust blocks shall be installed on all two and one-half (2-1/2) inch and larger bends and fittings. The minimum bearing surface shall be one (1.0) square foot. The thrust blocks shall be designed and installed per Section 02713-3.5 Thrust Restraint and the Thrust Block Standard Detail 2-2.
- D. The pipe in non-potable systems should be colored purple and marked on opposite sides of the pipe “CAUTION: NON-POTABLE WATER - DO NOT DRINK”.
- E. Tracer Wire shall be installed per Section 02621, Plastic Pressure Pipe.

2.4 POLYETHELENE PIPE AND FITTINGS

- A.** 80# SDR 18 (150 psi) pipe meeting ASTM D2239. Fittings shall be standard compression line fittings.
- B.** Sleeves for piping shall be a minimum of two (2) sizes larger than the pipe to be accommodated. Sleeves for control wire shall be a minimum of two (2) and shall be larger if necessary to easily accommodate and pull wire.
- C.** Thrust blocks shall be installed on all two and one-half (2-1/2) inch and larger bends and fittings. The minimum bearing surface shall be one (1.0) square foot. The thrust blocks shall be designed and installed per Section 02713-3.5 Thrust Restraint and the Thrust Block Standard Detail 2-2.
- D.** The pipe in non-potable systems should be colored purple and marked on opposite sides of the pipe "CAUTION: NON-POTABLE WATER - DO NOT DRINK".
- E.** Tracer Wire shall be installed per Section 02621, Plastic Pressure Pipe.

2.5 IRRIGATION VALVE BOX

- A.** Valve boxes shall be thermoplastic boxes manufactured for use in irrigation systems. Boxes shall have locking lids; lids shall be purple in color. Lids shall have the words "IRRIGATION CONTROL VALVE" or "CONTROL VALVE" and when applicable "NON-POTABLE WATER - DO NOT DRINK" imprinted on the top surface.
 - 1. Boxes shall be large enough to comfortably accommodate valve setup as required. Manufacturers are Carson and Armor or approved equal.

2.6 MANUAL ZONE VALVE

- A.** One (1) inch bronze ball valve with full opening port marked or tagged "NON-POTABLE" when applicable.

2.7 SPRINKLER HEADS

- A.** Shall be specified for the appropriate application.
- B.** The heads shall be purple color and marked "NON-POTABLE" when applicable.

2.8 QUICK COUPLERS

- A.** Non-potable Systems shall have covers colored purple and clearly marked "DO NOT DRINK".

1. Manufacturers:

- a Rainbird 33DNP, 44NP, 5NP or approved equal.

2.9 SURFACE WATER STORAGE FACILITY

- A. All irrigation water storage facilities must be reviewed and approved by the Town of Wellington prior to submittal of final design plans. All water storage facilities must be designed by a qualified engineer and shall meet all requirements of the applicable governing agencies.

2.10 WATER WELLS

Water wells used to supply irrigation water shall adhere to the following:

- A. The Town will not accept non-potable irrigation water wells that require augmentation. No wells will be accepted that are in the process of being adjudicated.
- B. All non-potable water wells must be adjudicated for irrigation of the properties they are to serve. Provide in a text box on the Drawings, the well permit number and the legal water right designation.
- C. The Contractor or Developer shall furnish along with other plans and specifications:
1. Location, to include a legal description of the well.
 2. Well depth and diameter.
 3. Description of materials encountered and depths.
 4. Results of Water Well Pump Test by accredited Water Well Drilling firm.
 5. Copy of the well permit.
 6. Copy of Colorado Water Rights decree.

D. TESTING

1. After the wells have been developed, the well owner must perform a three (3) hour pump test at a rate equal to one hundred (150) percent of the design flow
2. The Town Representative will observe the test and there must be seventy-two (72) hours notice given to the Town prior to testing.

3. Should the Developer/well owner use an existing well, the Town will at the well owners/Developers expense hire an independent well firm to evaluate the existing well. Based on the accumulative information, the Town will make an opinion on the acceptance of the well.
4. A drilling permit issued by the State Engineer is required prior to construction. Procurement of the permit will be the responsibility of the Developer. The driller must have a copy of the well permit and approval number on the drill site at all times.

E. MATERIALS

1. New wells shall be designed by qualified personnel and must meet all necessary regulations including all Colorado Department of Public Health and Environment regulations.
2. Existing wells shall be retrofitted to meet all necessary regulations including all Colorado Department of Public Health and Environment regulations.

2.11 IRRIGATION PUMP SYSTEMS

- A. All irrigation pump systems, electrical equipment, controls and buildings shall be reviewed and approved by the Town of Wellington prior to submittal of final design Drawings. A qualified engineer or manufacturer must design all irrigation pump systems. The Town reserves the right to review and comment on all aspects of the proposed pump system and controls.
 1. Variable Frequency Drive (VFD):
 - a The control system shall employ a VFD.

PART 3 EXECUTION

3.1 JOBSITE CONDITIONS

- A. Irrigation system installation shall be monitored, inspected, and approved by the Town. Irrigation systems shall be installed and maintained so that no heads spray onto any streets, sidewalks, passing motorists or pedestrians.
- B. Protection of Property (General): The Contractor shall be responsible for the preservation and protection of all existing utilities, trees, plants, survey pins, structures and paved areas. All damaged items shall be repaired or replaced to the satisfaction of the Town at the Contractor's expense.
- C. All existing irrigation lines, heads, valves, controllers and any and all other equipment not noted or specified to be changed, removed, relocated or

otherwise modified shall remain in place and shall be protected from damage during construction.

3.2 STAKING AND LAYOUT

- A.** Provide all manpower and materials necessary for the staking of the irrigation system in accordance with Drawings, Specifications and manufacturer's recommended spacing for proper distribution. After staking notify the Town a minimum of forty-eight (48) hours prior to commencing installation.
- B.** Upon construction acceptance, all heads and valves shall be surveyed and northings and eastings placed on the Record Drawings.

3.3 TRENCHING, BACKFILLING AND COMPACTION

- A.** Refer to Trenching, Backfilling, and Compacting, Section 02221.

3.4 INSTALLATION

- A.** Refer to Water Distribution and Transmission System, Section 02713.

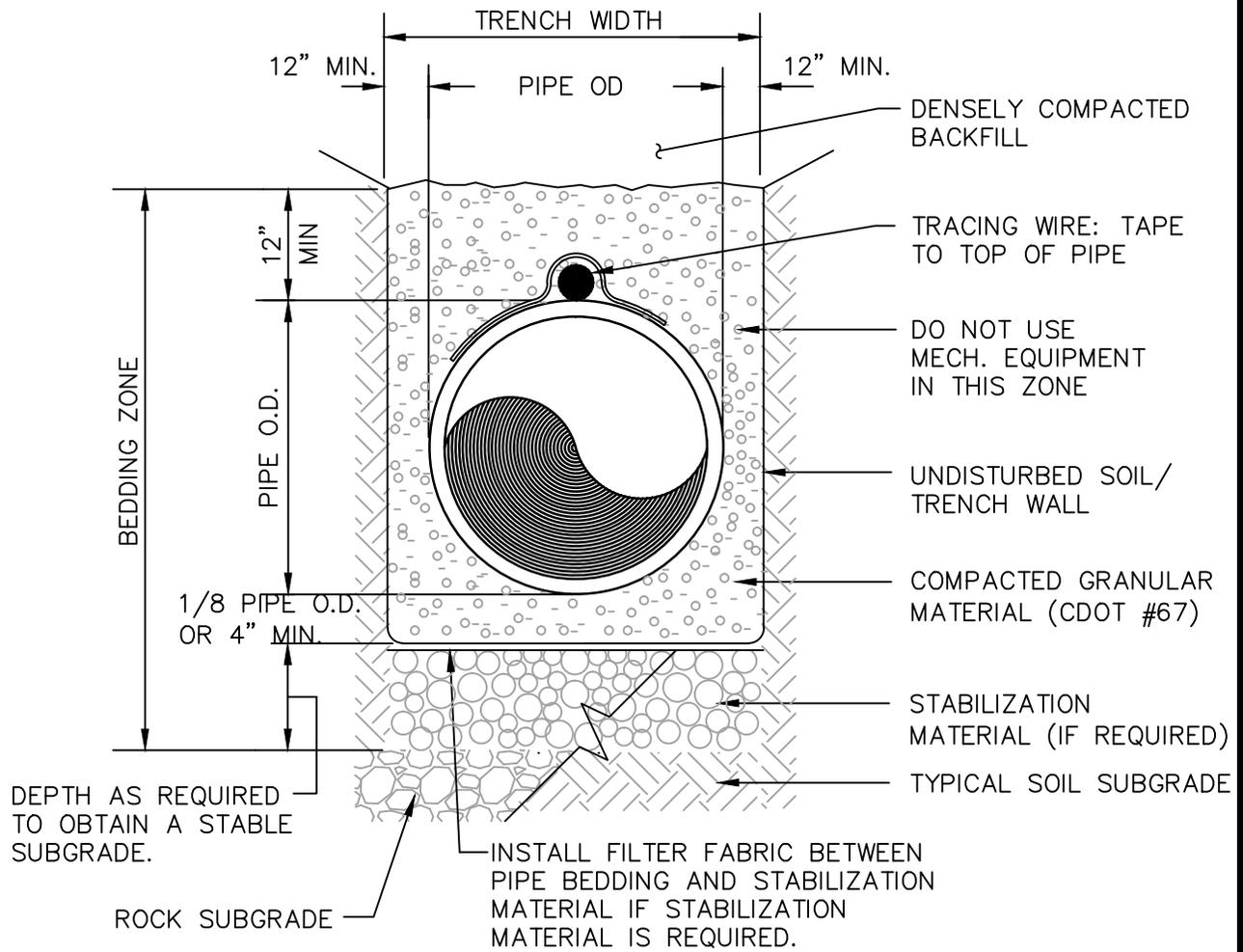
3.5 TESTING AND ACCEPTANCE

- A.** Pressure testing of piping and valves
 - 1. Refer to Testing and Inspection of Piping System, Section 01666.
- B.** Final Inspection
 - 1. Refer to General Requirements, Section 01000.

* * * END OF SECTION * * *

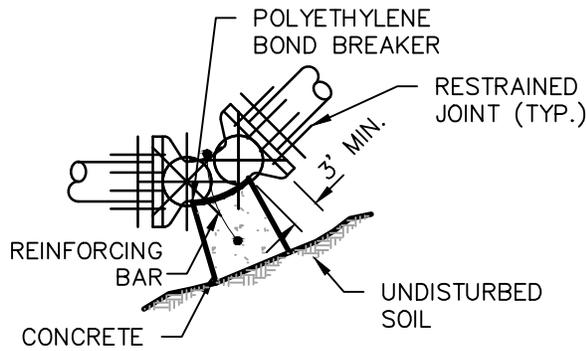
**DIVISION 2 –
WATER UTILITY**

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 Date Created: 2/26/2015 V:\52873\ACTIVE\187310055\2014 DEVELOPMENT STANDARDS - UPDATED\STANDARD DETAILS 2014\AUTOCAD\DIV 2 WATER DETAILS\DETAIL 2-1.DWG

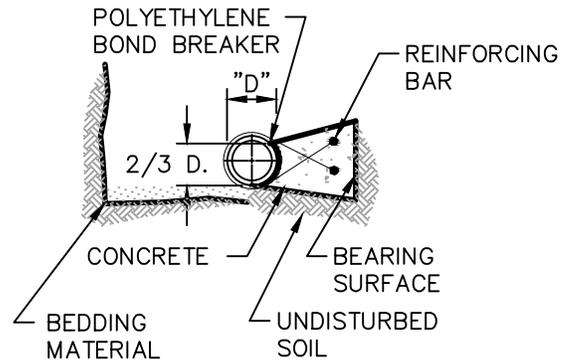


LATEST REV.	BEDDING DETAIL – PVC WATER DISTRIBUTION PIPE	DWG. REF.
March 2015	TOWN OF WELLINGTON, COLORADO	2-1

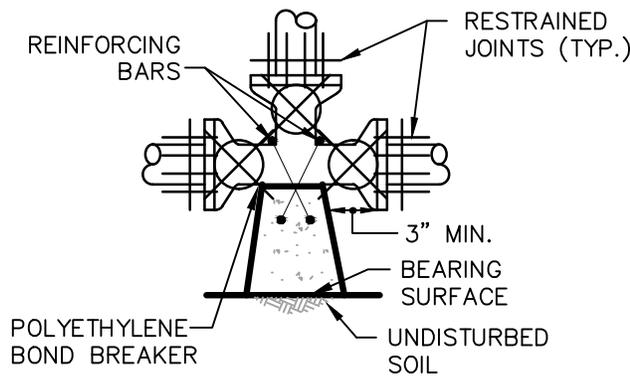
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TYPICAL BEND



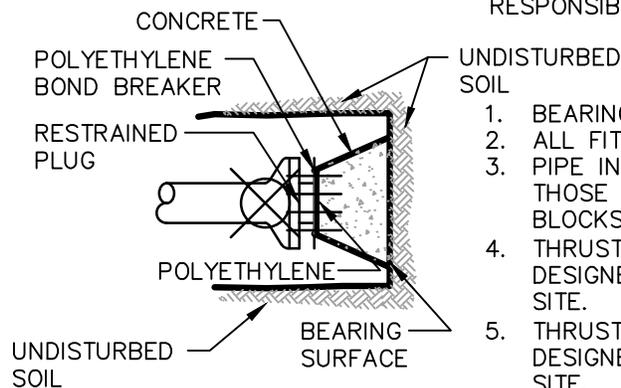
TYPICAL CROSS SECTION



TEE

PIPE SIZE	BENDS				TEE OR DEAD END
	11 1/4°	22 1/2°	45°	90°	
6"	1.0	1.5	2.5	4.5	3.5
8"	1.5	2.5	4.5	8.0	5.5
12"	3.0	4.5	9.0	16.5	12.0
16"	4.8	9.6	18.9	34.7	24.5

* BEARING SURFACE AREAS SHOWN IN CHART ARE A MINIMUM REQUIREMENT AND DO NOT RELIEVE THE DESIGN ENGINEER OF RESPONSIBILITY TO DESIGN EACH THRUST BLOCK.



DEAD END

GENERAL NOTES:

1. BEARING SURFACE AREAS SHOWN IN CHART ARE MINIMUM.
2. ALL FITTINGS TO BE WRAPPED WITH POLYETHYLENE.
3. PIPE INSTALLED UNDER CONDITIONS DIFFERENT FROM THOSE NORMALLY ENCOUNTERED SHALL REQUIRE THRUST BLOCKS DESIGNED FOR THOSE PARTICULAR CONDITIONS.
4. THRUST BLOCKS ON PIPE LARGER THAN 16" SHALL BE DESIGNED FOR CONDITIONS EXISTING AT THE INSTALLATION SITE.
5. THRUST BLOCKS ON PIPE LARGER THAN 16" SHALL BE DESIGNED FOR CONDITIONS EXISTING AT THE INSTALLATION SITE.
6. REFER TO SECTION 02713 FOR CONCRETE REQUIREMENTS.
7. SEE RELEVANT SPECIFICATION FOR FURTHER DETAIL.

LATEST REV.

THRUST BLOCK DETAIL

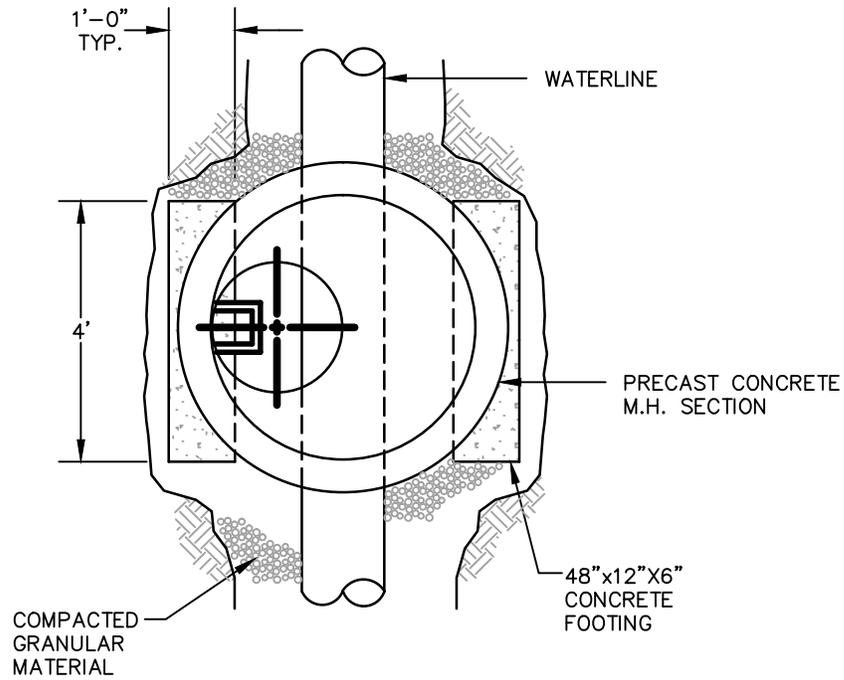
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March 2015

TOWN OF WELLINGTON, COLORADO

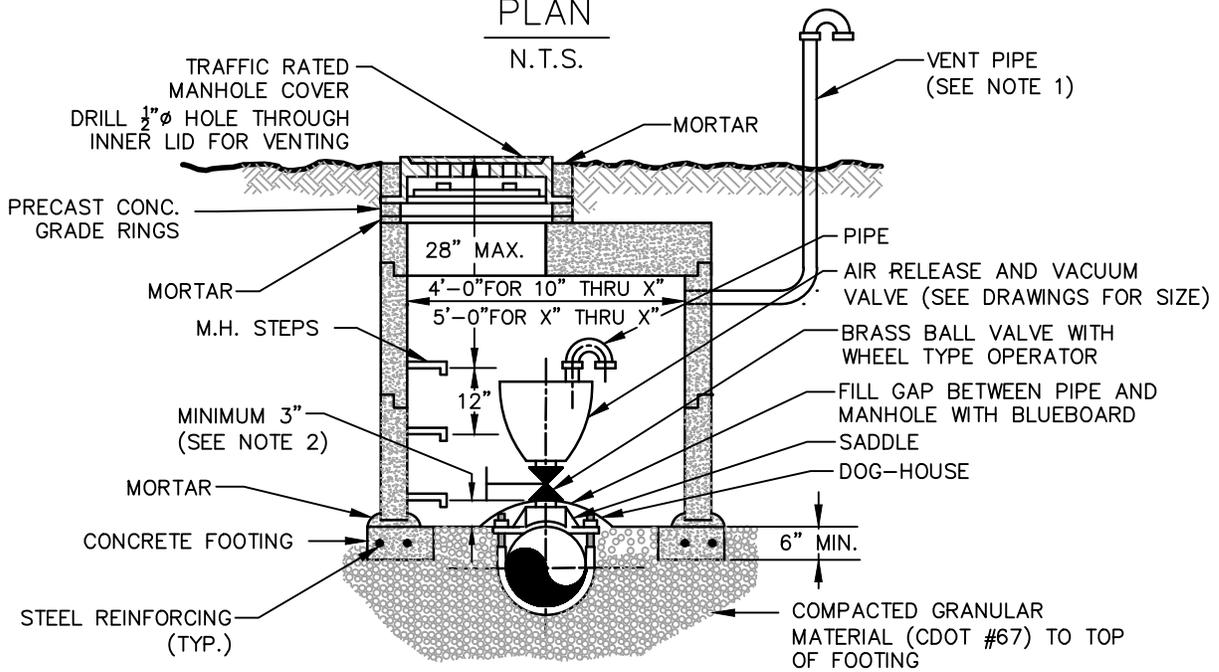
2-2

Plot Date: 3/3/2015 8:07 AM Plotted By: Bowen, Corey
 Date Created: 2/26/2015 V:\52873\ACTIVE\187310055\2014 DEVELOPMENT STANDARDS - UPDATED\STANDARD DETAILS 2 WATER DETAILS\DETAIL 2-4.DWG



PLAN

N.T.S.



SECTION

N.T.S.

NOTES

1. VENT PIPE REQUIRED ONLY FOR PIPES 18" ϕ AND LARGER
2. MANHOLE SHALL CLEAR AND NOT REST ON PIPE.

LATEST REV.

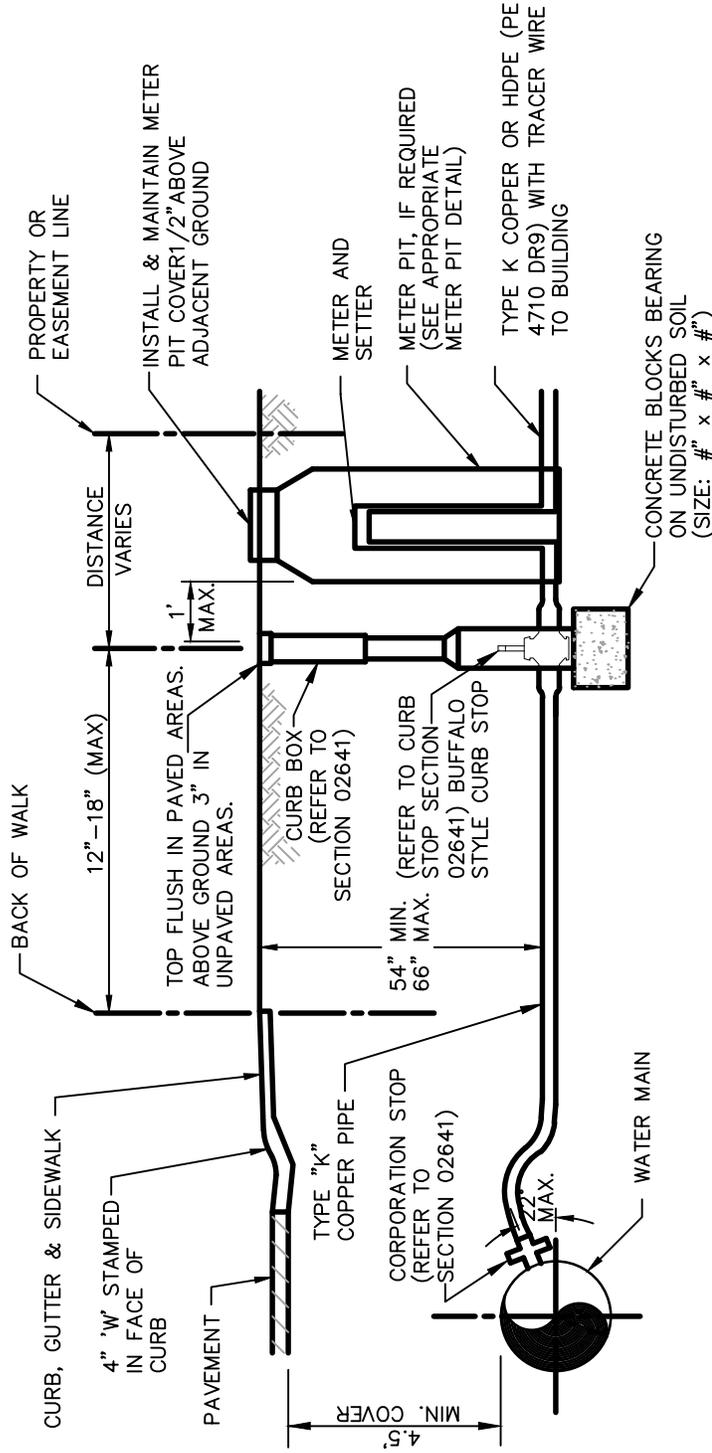
STD. AIR & VACUUM RELIEF VALVE

DWG. REF.

March 2015

TOWN OF WELLINGTON, COLORADO

2-4

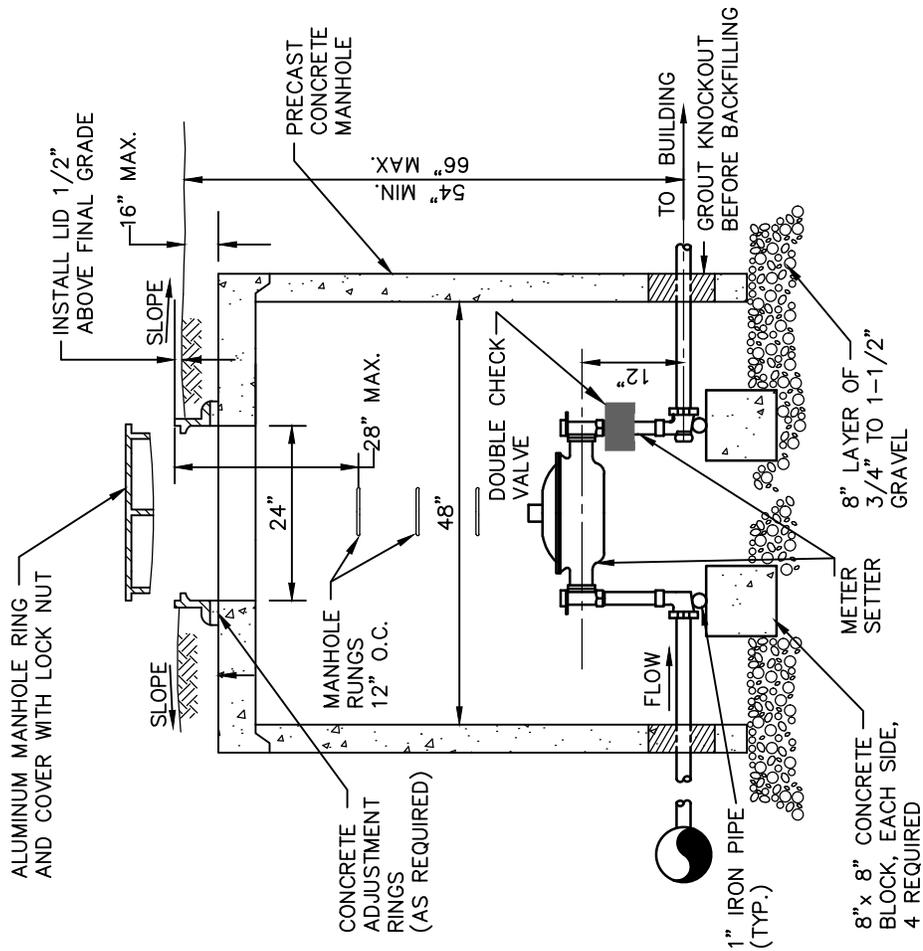


GENERAL NOTES:

1. USE TAPPING SADDLE FOR 3/4-INCH AND 2-INCH SERVICES.
2. TOWN'S RESPONSIBILITY FOR MAINTENANCE SHALL BE FROM THE WATER MAIN UP TO AND INCLUDING THE CURB STOP. PROPERTY OWNER'S RESPONSIBILITY SHALL BE FROM CURB STOP TO BUILDING.
3. NO COUPLINGS SHALL BE ALLOWED BETWEEN CURB STOP AND METER SETTER.
4. SERVICE SHALL BE TYPE K COPPER FROM MAIN TO CURB STOP.
5. SERVICE SHALL BE TYPE K COPPER OR HDPE (PE 4710 DR9) WITH TRACER WIRE FROM CURB STOP TO HOUSE.
6. AT TIME OF TOWN INSPECTION OF SERVICE CONNECTION TO HOUSE, THE CONTRACTOR SHALL BE PRESENT ON-SITE WITH BUILDING PERMIT.

LATEST REV.	WATER SERVICE CONNECTION (TYP. 3/4" - 2")
March 2015	TOWN OF WELLINGTON, COLORADO

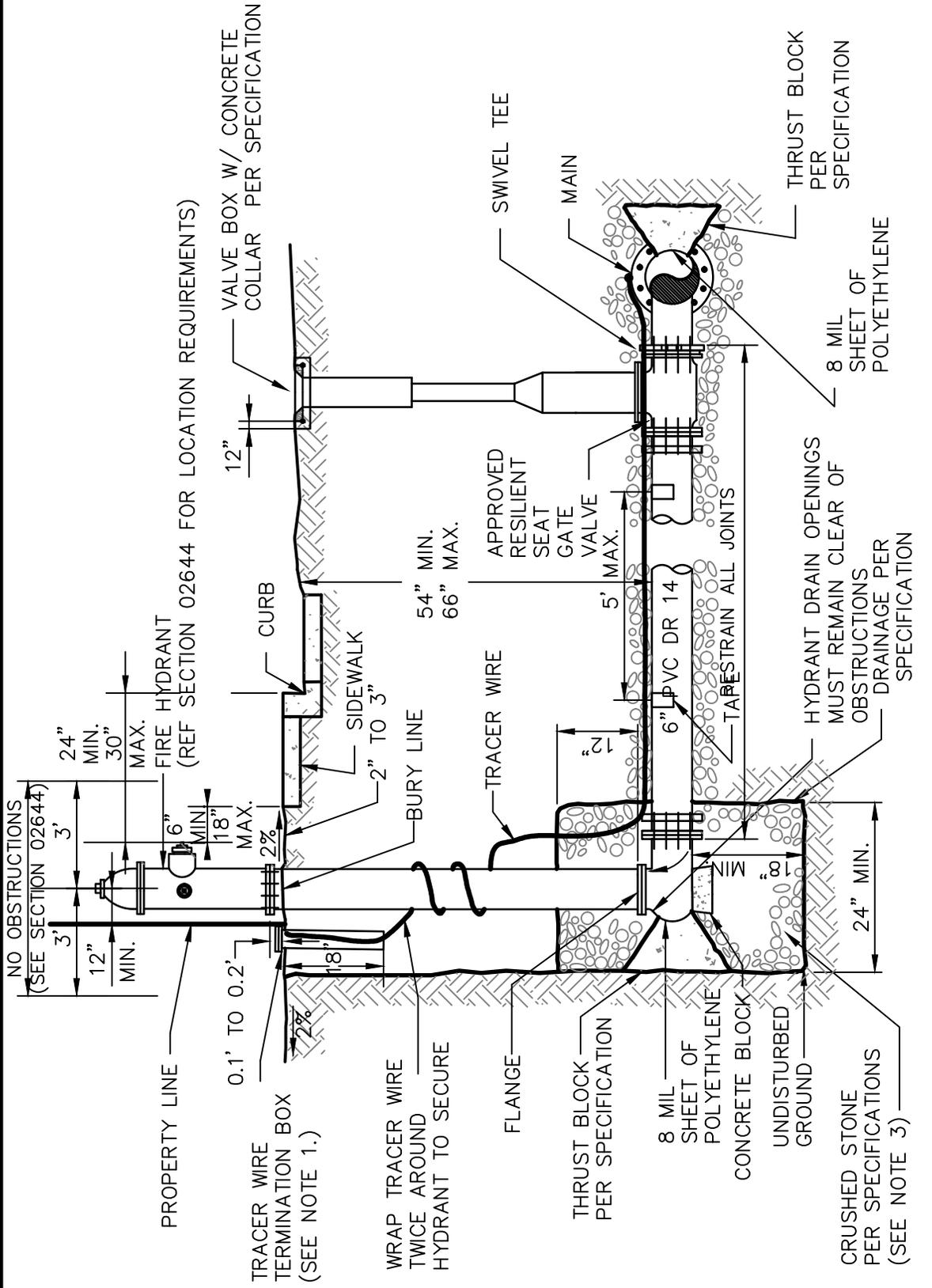
DWG. REF.	2-5
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GENERAL NOTES:

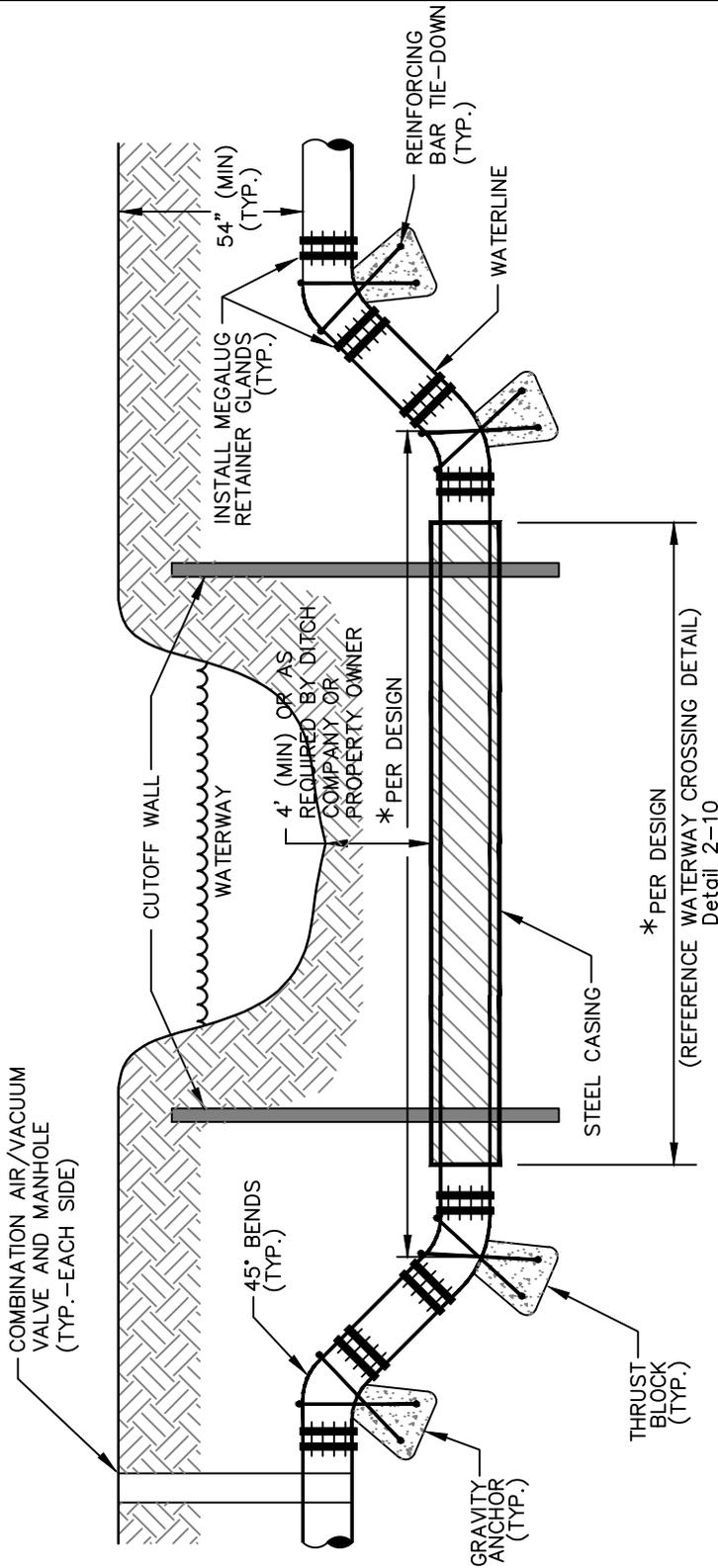
1. METER SETTERS TO BE SUPPORTED BY 2 - 18" LENGTHS OF 1" IRON PIPE INSERTED THROUGH EYES AND SET ATOP 8" x 8" CONCRETE BLOCKS.
2. THIS METER PIT NOT TO BE INSTALLED IN ANY STREET, ALLEY, PARKING AREA OR DRIVEWAY.
3. NO LANDSCAPING (TREES, SHRUBS, BOULDERS, ETC.) TO BE WITHIN 3 FEET OF METER PIT.
4. GROUND SURROUNDING METER PIT SHALL SLOPE AWAY FROM LID.
5. NO PLUMBING CONNECTIONS TO BE MADE IN METER PIT.
6. LAWN SPRINKLER CONNECTIONS TO BE AT LEAST 5 FEET FROM METER PIT WALL ON THE OUTLET SIDE.
7. GRADE CHANGES AFTER METER PIT INSTALLATION SHALL REQUIRE THAT THE PROPERTY OWNER ADJUST METER PIT COVER TO 1/2" ± ABOVE FINAL GRADE.
8. IF PRESSURE REDUCING VALVE IS REQUIRED BY PLUMBING CODE, IT SHALL BE INSTALLED INSIDE THE BUILDING, IMMEDIATELY FOLLOWING THE MAIN SHUT OFF VALVE.
- 9.. BY PASS IF REQUIRED

LATEST REV.	STANDARD SETTING FOR 1-1/2" & 2" METERS	DWG. REF.
March 2015	TOWN OF WELLINGTON, COLORADO	2-6



- NOTES:
1. TERMINATE TRACER WIRE IN 18" PIECE OF 3" PLASTIC CONDUIT BOX W/ METAL CASTING. 2' OF WIRE SHALL BE COILED INSIDE OF BOX. PRODUCT EQUAL TO A CATHODIC PROTECTION MINI-TEST STATION.
 2. ALL FITTINGS AND MECHANICAL JOINTS SHALL BE INSTALLED WITH RESTRAINED JOINT GLANDS.
 3. CRUSHED STONE SHALL EXTEND A MIN. OF 12" EITHER SIDE OF PIPE, OR 13 CUBIC FEET OF MATERIAL.

LATEST REV.	FIRE HYDRANT DETAIL	DWG. REF.
March 2015	TOWN OF WELLINGTON, COLORADO	2-8



NOTES:

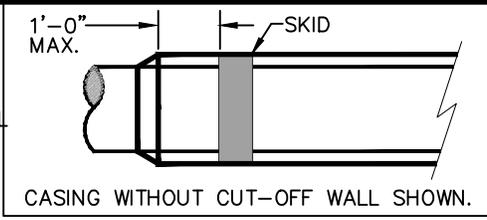
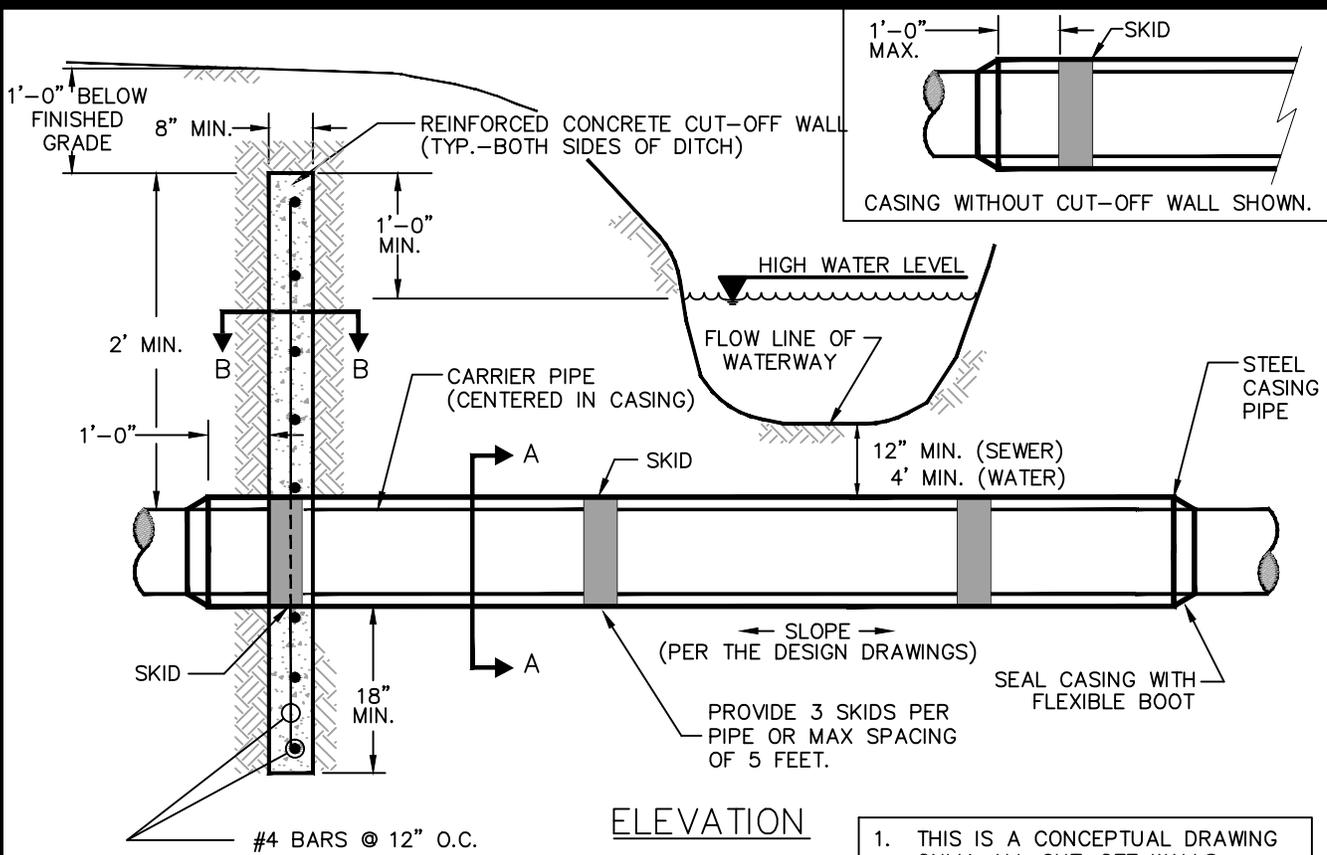
1. THRUST BLOCKS— SIZE PER DESIGN STANDARDS.
2. GRAVITY ANCHORS SIZED TO RESIST UPLIFT AND SLIDING. SUBMIT DESIGN CALCS TO TOWN ENGINEER FOR REVIEW.
3. ALL PIPE AND FITTINGS ARE TO BE WRAPPED W/ POLYETHYLENE WRAP.
4. ENGINEER SHALL SUBMIT CASING PIPE CALCULATIONS AND SPECIFICATIONS FOR REVIEW AND APPROVAL
5. ALL FITTINGS AND MECHANICAL JOINTS SHALL BE INSTALLED WITH RESTRAINED JOINT GLANDS.

LATEST REV.	
March 2015	

WATERLINE: CROSSING DETAIL
 TOWN OF WELLINGTON, COLORADO

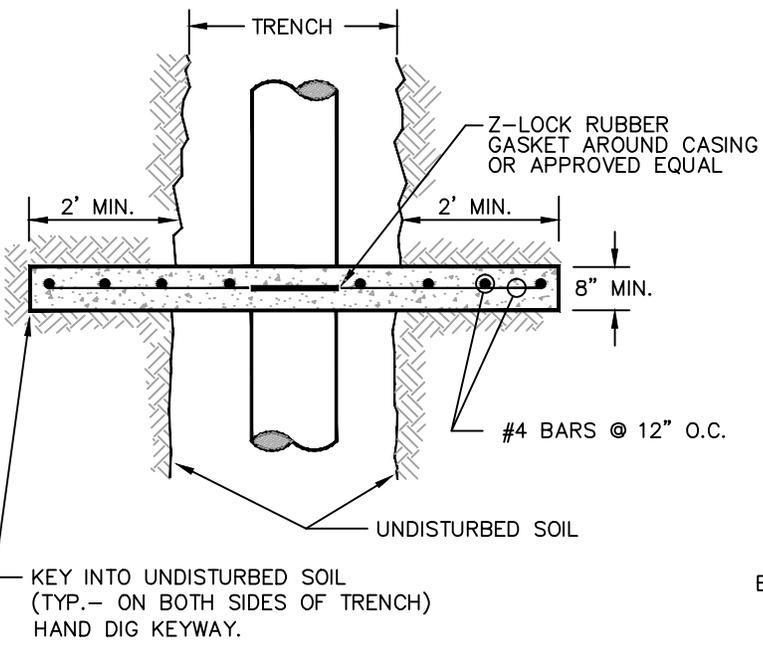
DWG. REF.	
2-9	

Plot Date: 3/3/2015 8:20 AM Plotted By: Bowen, Corey
 Date Created: 2/26/2015 V:\52873\FACTIVE\187310055\2014 DEVELOPMENT STANDARDS - UPDATED\STANDARD DETAILS 2014\AUTOCAD\DIV 2 WATER DETAILS\DETAIL 2-10.DWG

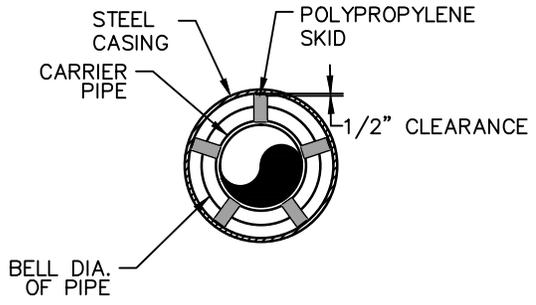


ELEVATION

1. THIS IS A CONCEPTUAL DRAWING ONLY. ALL CUT-OFF WALLS SHALL BE DESIGNED BY THE DESIGN ENGINEER FOR THE SPECIFIC INSTALLATION.
2. ALL FITTINGS AND MECHANICAL JOINTS SHALL BE INSTALLED WITH RESTRAINED JOINT GLANDS.
3. STEEL CASING PIPE SHALL BE DESIGNED BY ENGINEER.
4. DESIGN SHALL MEET THE REQUIREMENTS OF THE DITCH COMPANY.



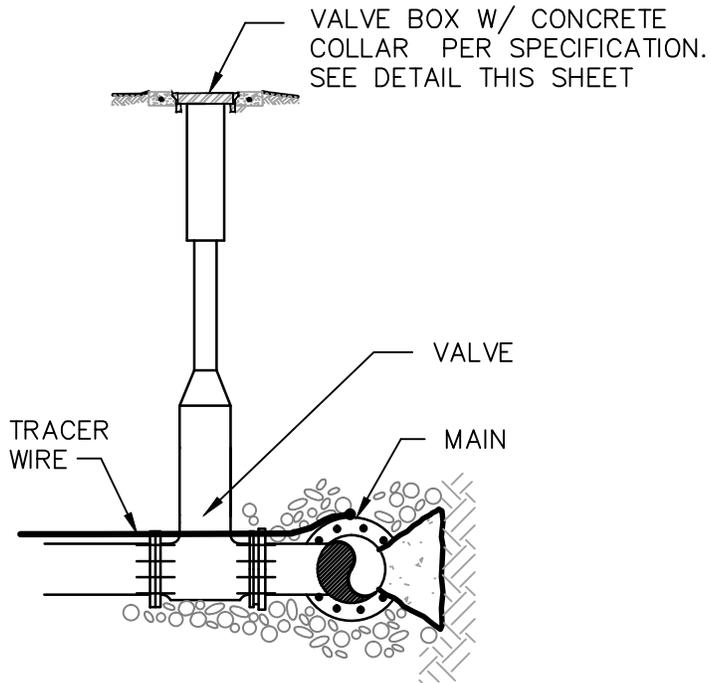
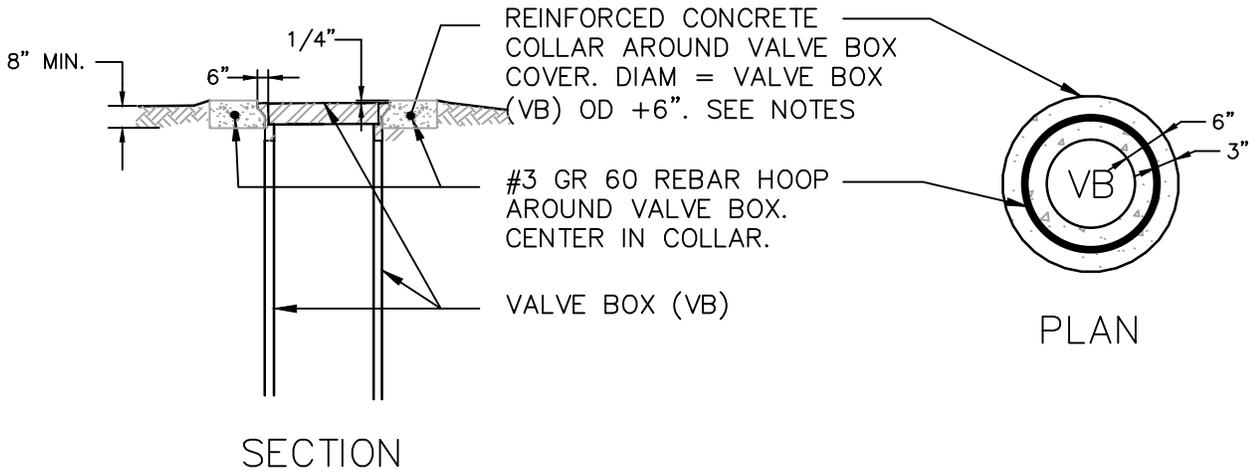
SECTION B-B



SECTION A-A

LATEST REV.	WATERWAY CROSSING DETAIL	DWG. REF.
March 2015	TOWN OF WELLINGTON, COLORADO	2-10

Plot Date: 3/3/2015 8:21 AM Plotted By: Bowen, Corey
 Date Created: 2/26/2015 V:\52873F\ACTIVE\187310055\2014 DEVELOPMENT STANDARDS - UPDATED\STANDARD DETAILS 2014\AUTOCAD\DIV 2 WATER DETAILS\DETAIL 2-11.DWG



NOTES

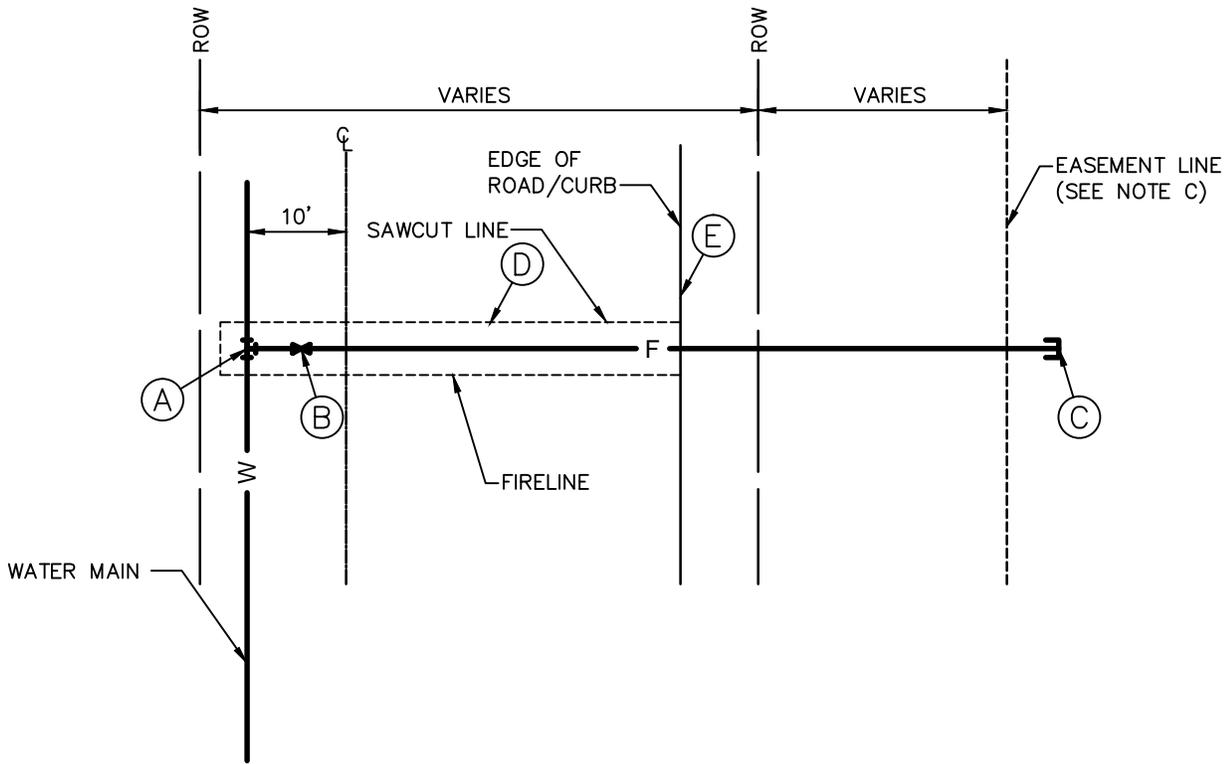
1. ALL VALVE BOXES SHALL HAVE A 6" CONCRETE COLLAR AROUND THE VALVE BOX.
2. CONCRETE SHALL BE 3500 PSI MIN.
3. PROVIDE #3 GR 60 REBAR HOOP IN CONCRETE AROUND THE VALVE BOX COVER. INSTALL W/ 6" SPLICE LENGTH.

LATEST REV.
March 2015

VALVE BOX COVER WITH CONCRETE COLLAR
TOWN OF WELLINGTON, COLORADO

DWG. REF.
2-11

Plot Date: 3/4/2015 9:46 AM Plotted By: Bowen, Corey
 Date Created: 3/4/2015 V:\52873\FACTIVE\187310055\2014 DEVELOPMENT STANDARDS - UPDATED\STANDARD DETAILS 2014\AUTOCAD\DIV 2 WATER DETAILS\DETAIL 2-12.DWG



GENERAL NOTES:

1. WATERLINE IS LOCATED 10-FT WEST OR NORTH OF CENTERLINE OF ROAD PER TOWN STANDARDS UNLESS APPROVED IN WRITING BY THE TOWN.
2. FIRE LINE SHALL BE A MINIMUM OF 4-INCH DIAMETER C900 PVC PIPE. SEE PLANS FOR ACTUAL FIRE LINE DIAMETER.
3. NO TREES OR BUSHES TO BE PLANTED WITHIN 10- FEET OF FIRE LINE.
4. ATTACH TRACER WIRE TO FIRE LINE FROM MAIN TO THE BUILDING.
5. REFERENCE TOWN OF WELLINGTON SPECIFICATION SECTIONS 01666,02221,02321,, 02621 & 02641.

CONSTRUCTION NOTES:

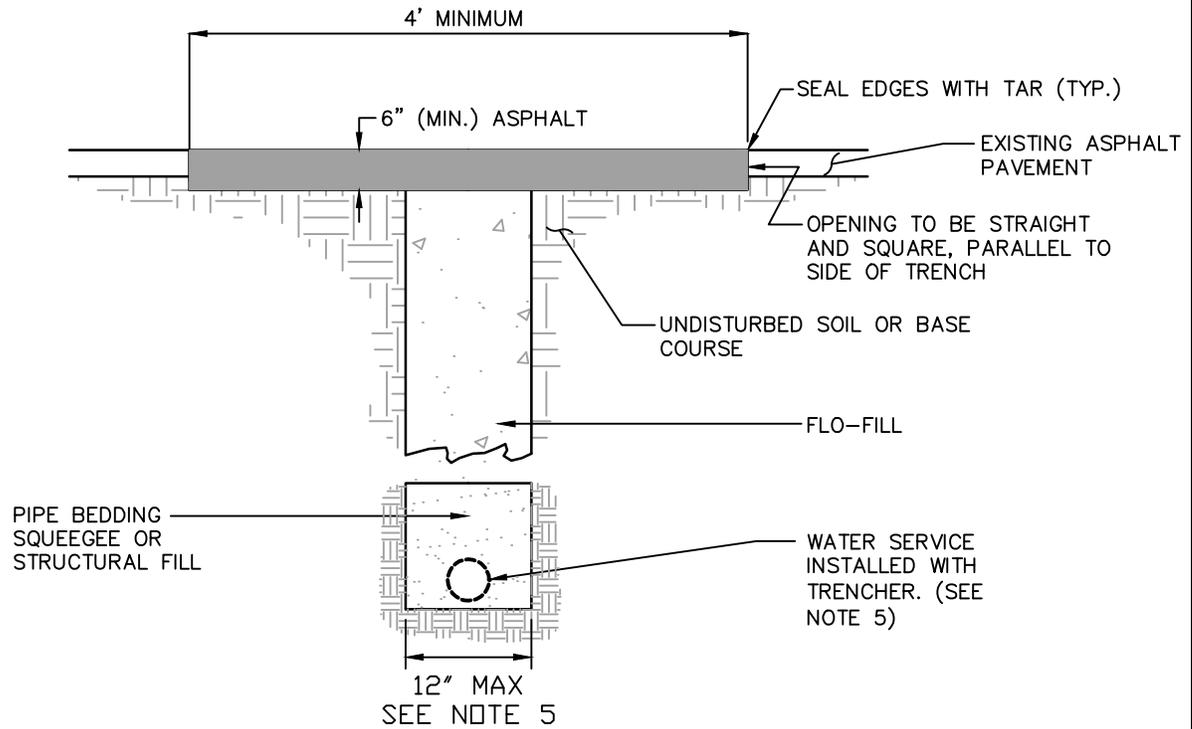
- A. INSTALL TEE IN MAIN LINE WITH MEGALUGS AND THRUST BLOCK AT LOCATION SHOWN ON PLANS. SEE PLANS FOR MAIN LINE PIPE DIAMETER AND FIRE LINE PIPE DIAMETER (MINIMUM 4-INCHES).
- B. INSTALL GATE VALVE IN FIRE LINE WITH VALVE BOX. SEE PLANS FOR FIRE LINE PIPE DIAMETER (MINIMUM 4-INCHES).
- C. EXTEND FIRE LINE TO ROW LINE OR EASEMENT LINE WHICHEVER IS FURTHEST FROM CENTERLINE AND PLUG TEMPORARILY. SEE SITE PLANS FOR EXTENSION OF FIRE LINE TO BUILDING OR STRUCTURE.
- D. FOR EXISTING ROADWAYS ONLY – EXISTING PAVEMENT SHALL BE SAW CUT OR WHEEL CUT TO OBTAIN A STRAIGHT NEAT EDGE FOR PAVING. SAWCUT SHALL BE MADE PRIOR TO PAVING AFTER BACKFILL TO SUBGRADE IS COMPLETED. REFERENCE DETAIL 2-3 FOR ADDITIONAL INFORMATION.
- E. FOR EXISTING CURB AND GUTTER ONLY – REMOVE AND REPLACE EXISTING CURB AND GUTTER THAT IS DAMAGED BY THE INSTALLATION OF THE FIRE LINE TO THE NEAREST JOINT.

LATEST REV.	
March 2015	

FIRE SERVICE DETAIL
TOWN OF WELLINGTON, COLORADO

DWG. REF.	
2-12	

Plot Date: 3/4/2015 9:27 AM Plotted By: Bowen, Corey
 Date Created: 2/26/2015 V:\52873\ACTIVE\187310055\2014 DEVELOPMENT STANDARDS - UPDATED\STANDARD DETAILS 2014\AUTOCAD\DIV 2 WATER DETAILS\DETAIL 2-13.DWG

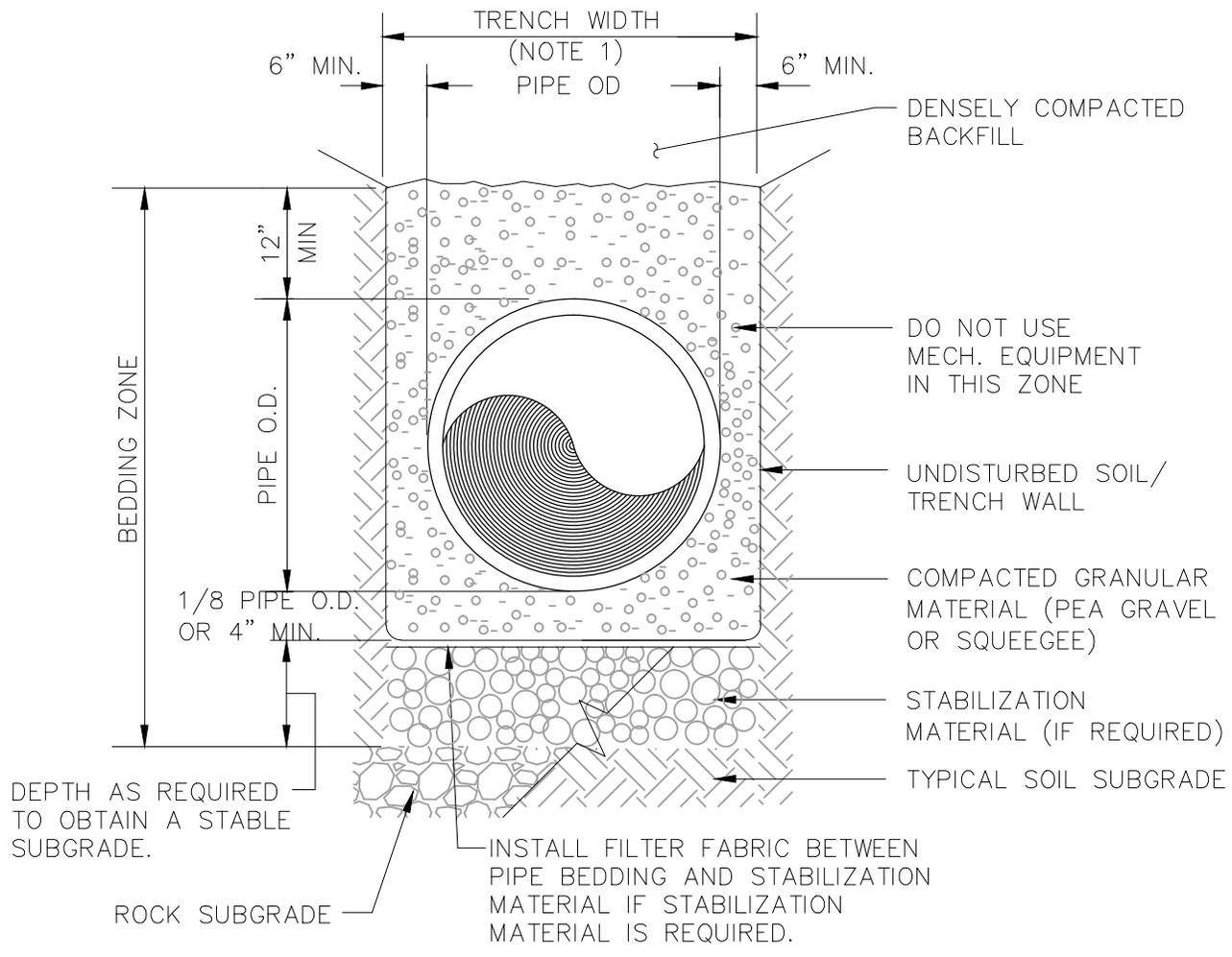


NOTES:

1. EXISTING PAVEMENT SHALL BE SAW OR WHEEL CUT TO OBTAIN A STRAIGHT AND NEAT EDGE FOR PAVING. SAW CUT SHALL BE MADE PRIOR TO PAVING AFTER BACKFILL TO BOTTOM OF NEW PAVEMENT.
2. PRIOR TO INSTALLATION OF PATCH, ALL EDGES OF EXISTING ASPHALT SHALL HAVE A TACK COAT APPLIED.
3. AFTER ALL ASPHALT HAS BEEN PLACED, ALL SEAMS BETWEEN NEW AND EXISTING PAVEMENT SHALL BE SEALED WITH AN ASPHALTIC TAR.
4. TOP OF NEW ASPHALT PAVEMENT SHALL MATCH THE TOP OF THE EXISTING PAVEMENT. ASPHALT PAVEMENT MINIMUM THICKNESS SHALL BE 6".
5. FLO-FILL TO EXTEND ALONG THE SERVICE TRENCH TO BACK OF WALK FOR REPLACEMENT SERVICES AND NEW SERVICES INSTALLED USING TRENCHER. SEE DETAIL 2-3 FOR EXCAVATED SERVICE TRENCHES.
6. REFERENCE SPECIFICATIONS SECTIONS 02221 & 02321.

LATEST REV.	REPLACING ASPHALTIC CONCRETE PAVEMENT FOR NARROW WATER SERVICE TRENCH	DWG. REF.
March 2015	TOWN OF WELLINGTON, COLORADO	2-13

Plot Date: 3/5/2015 10:11 AM Plotted By: Oberschmidt, Mark
 Date Created: 3/5/2015 V:\52873F\ACTIVE\187310055\2014 DEVELOPMENT STANDARDS - UPDATED\STANDARD DETAILS 2014\AUTOCAD\DIV 2 WATER DETAILS\DETAIL_2-14.DWG



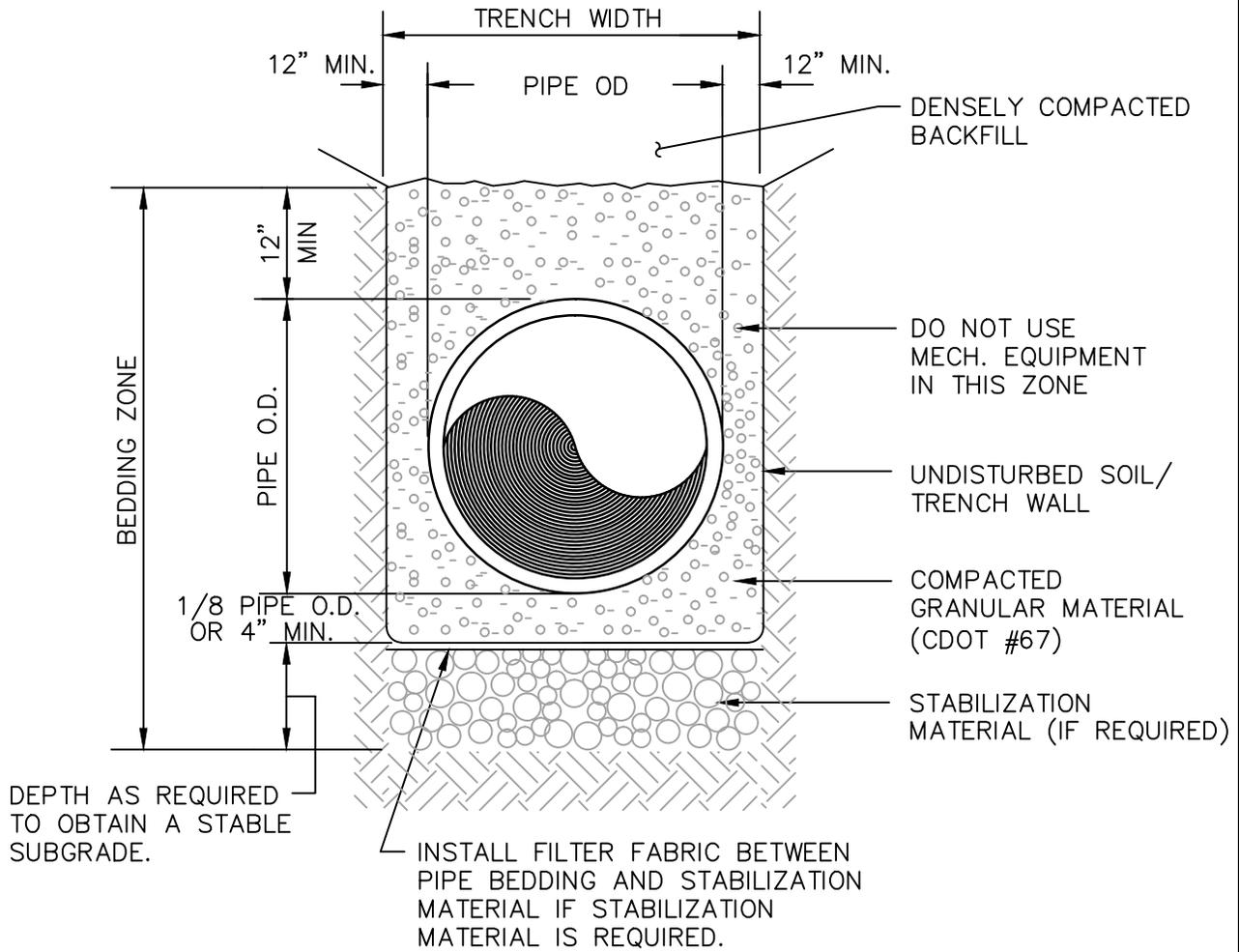
NOTES

1. MINIMUM TRENCH WIDTH SHOWN ASSUMES INSTALLATION BY TRENCHING MACHINE NOT AN EXCAVATOR.

LATEST REV.	BEDDING DETAIL – TYPE K WATER SERVICE	DWG. REF.
March 2015	TOWN OF WELLINGTON, COLORADO	2-14

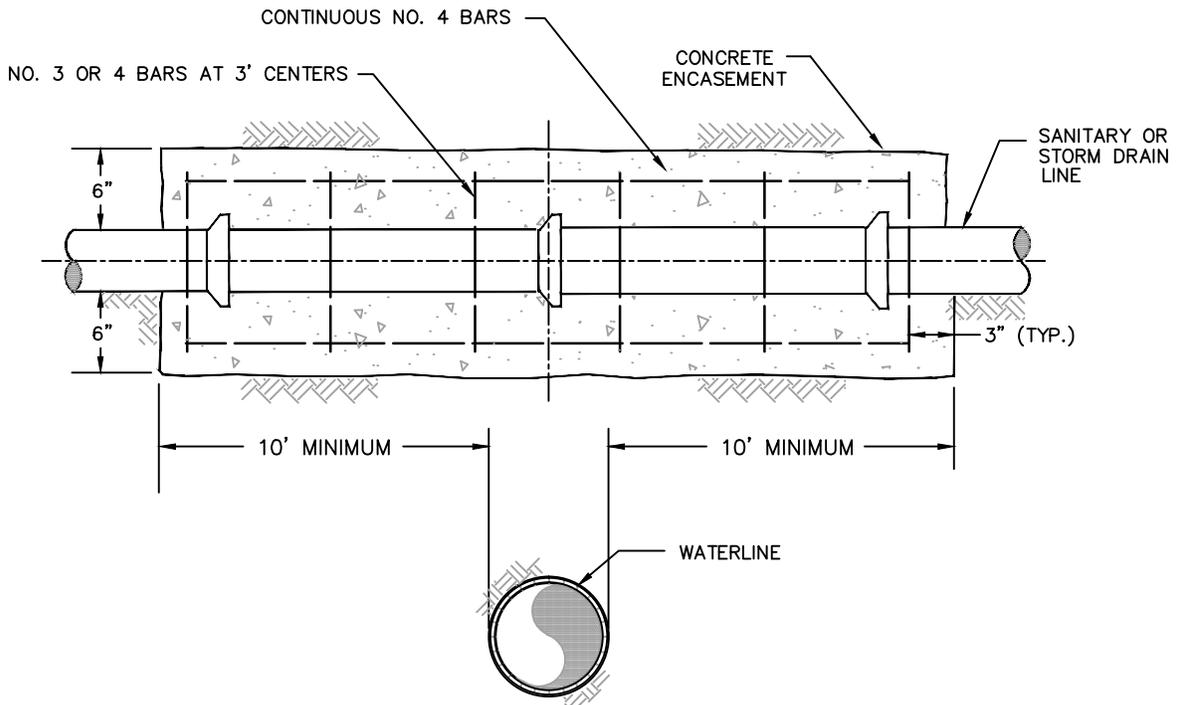
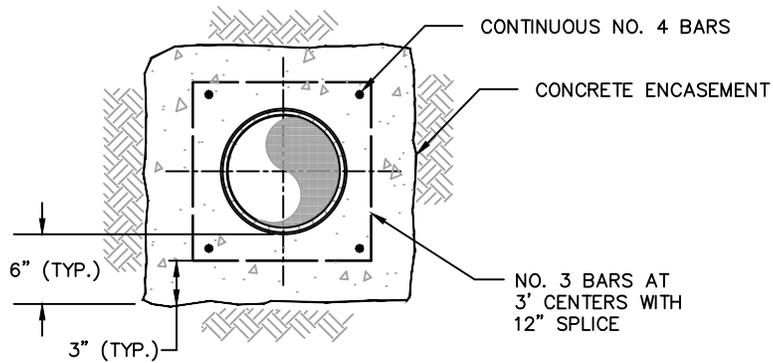
**DIVISION 3 –
SANITARY SEWER**

Plot Date: 3/3/2015 8:25 AM Plotted By: Bowen, Corey
 Date Created: 2/26/2015 V:\52873\ACTIVE\187310055\2014 DEVELOPMENT STANDARDS - UPDATED\STANDARD DETAILS 2014\AUTOCAD\DIV 3 SEWER DETAILS\DETAIL 3-1.DWG



LATEST REV.	BEDDING DETAIL FOR PVC SEWER PIPE	DWG. REF.
March 2015	TOWN OF WELLINGTON, COLORADO	3-1

Plot Date: 3/3/2015 8:25 AM Plotted By: Bowen, Corey
 Date Created: 2/26/2015 V:\52873\ACTIVE\187310055\2014 DEVELOPMENT STANDARDS - UPDATED\STANDARD DETAILS 2014\AUTOCAD\DIV 3 SEWER DETAILS\DETAIL 3-2.DWG



NOTES:

1. CONCRETE ENCASEMENT IS REQUIRED ON STORM DRAIN AND SANITARY SEWER WHEN THEY ARE BELOW WATERLINE AND CLEAR VERTICAL DISTANCE FROM WATERLINE IS LESS THAN 18" OR HORIZONTAL DISTANCE IS LESS THAN 10' BETWEEN PARALLEL LINES.
2. CONCRETE ENCASEMENT IS REQUIRED IN ALL CASES WHERE STORM DRAIN OR SANITARY SEWER IS CROSSING OVER WATERLINE.

LATEST REV.

CONCRETE ENCASEMENT DETAIL
 TOWN OF WELLINGTON, COLORADO

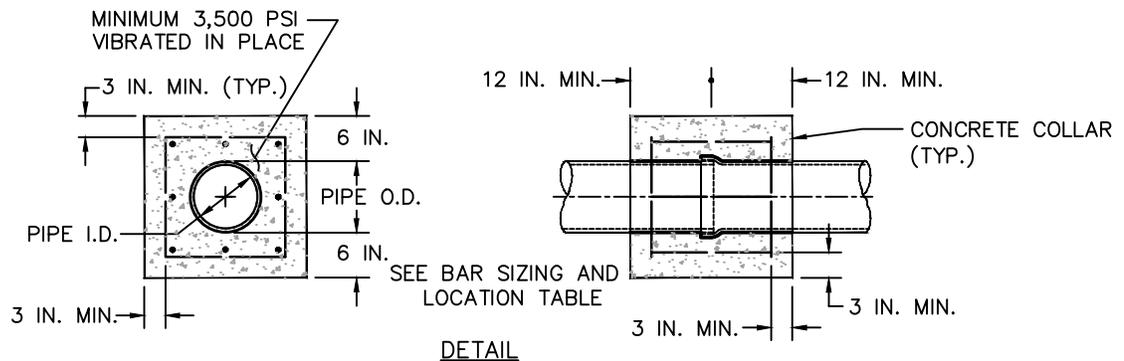
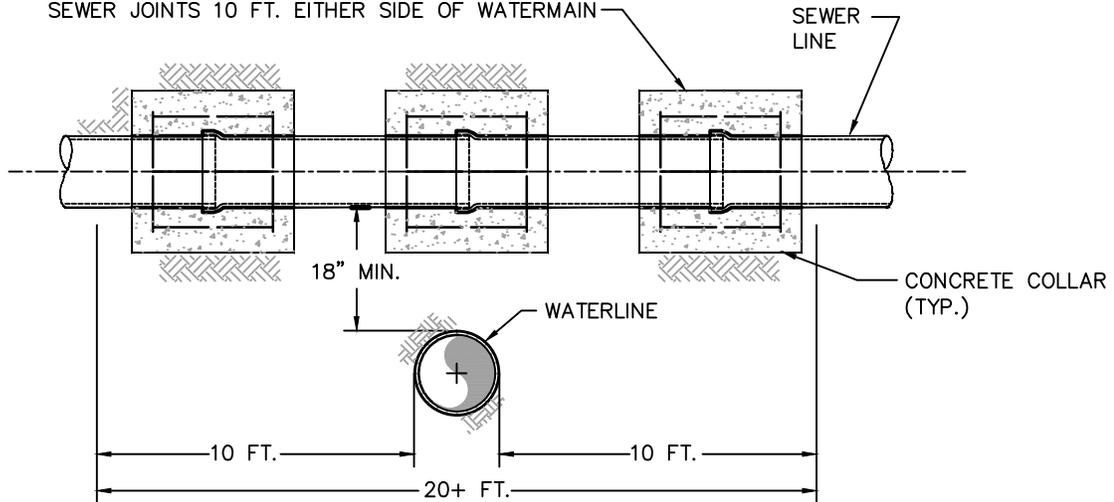
DWG. REF.

March 2015

3-2

Plot Date: 3/3/2015 8:26 AM Plotted By: Bowen, Corey Date Created: 2/26/2015 V:\52873\FACTIVE\187310055\2014 DEVELOPMENT STANDARDS - UPDATED\STANDARD DETAILS 2014\AUTOCAD\DIV 3 SEWER DETAILS\DETAIL 3-3.DWG

PLACE CONCRETE JOINT ENCASEMENTS ON ALL SEWER JOINTS 10 FT. EITHER SIDE OF WATERMAIN



DETAIL

PIPE I.D.	NO. OF LONGITUDINAL BARS AND LOCATION		
15 IN.	8 - NO. 4 BARS	3 EACH	SIDE
18 IN.	8 - NO. 4 BARS	3 EACH	SIDE
21 IN.	12 - NO. 4 BARS	4 EACH	SIDE
24 IN.	12 - NO. 4 BARS	4 EACH	SIDE
27 IN.	12 - NO. 4 BARS	4 EACH	SIDE
30 IN.	12 - NO. 4 BARS	4 EACH	SIDE
33 IN.	12 - NO. 4 BARS	4 EACH	SIDE
36 IN.	16 - NO. 4 BARS	5 EACH	SIDE

LATEST REV.

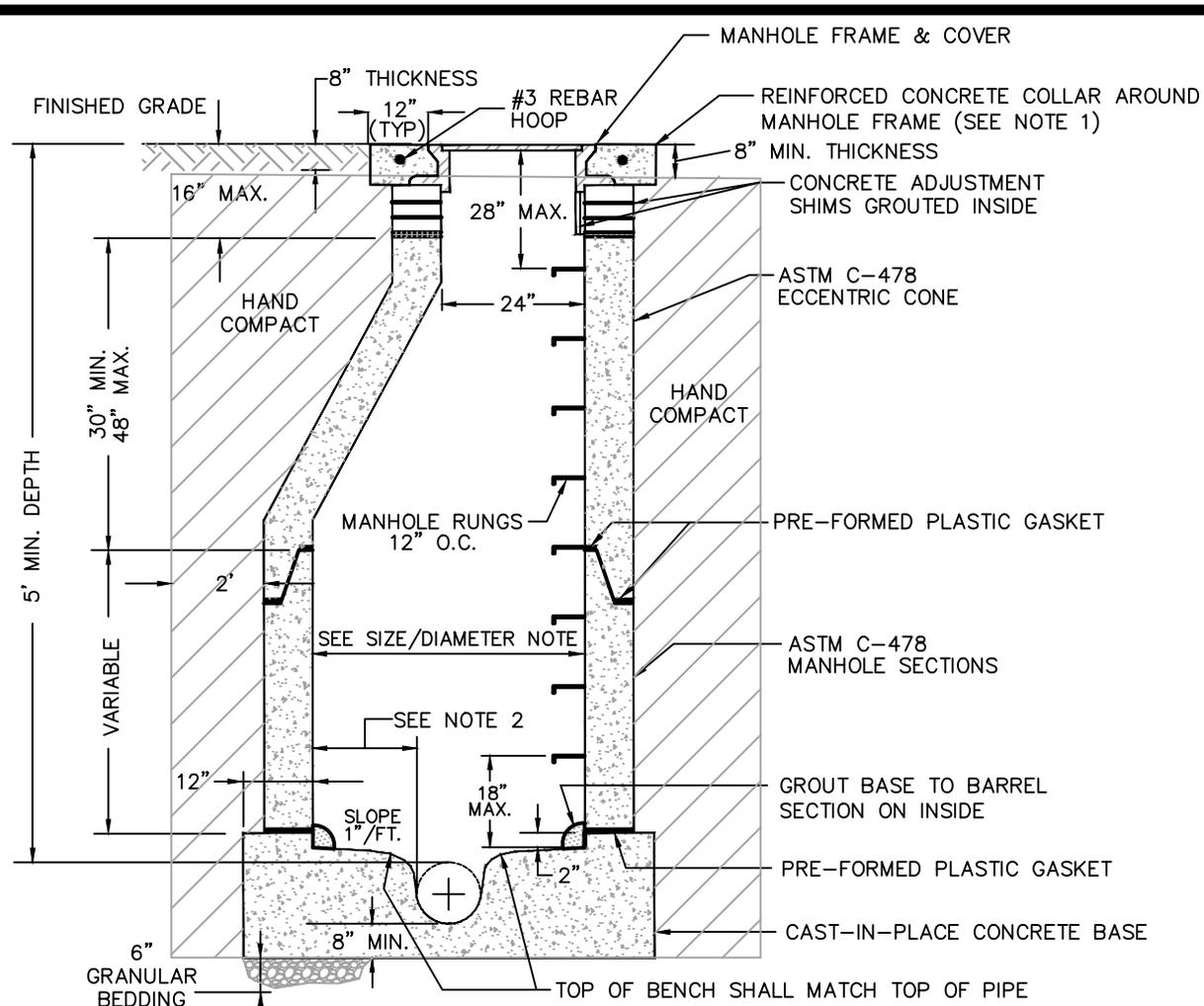
SEWER JOINT ENCASEMENT DETAIL
TOWN OF WELLINGTON, COLORADO

DWG. REF.

March 2015

3-3

Plot Date: 3/3/2015 8:27 AM Plotted By: Bowen, Corey
 Date Created: 2/26/2015 V:\52873\FACTIVE\187310055\2014 DEVELOPMENT STANDARDS - UPDATED\STANDARD DETAILS 3 SEWER DETAILS\DETAIL 3-4.DWG

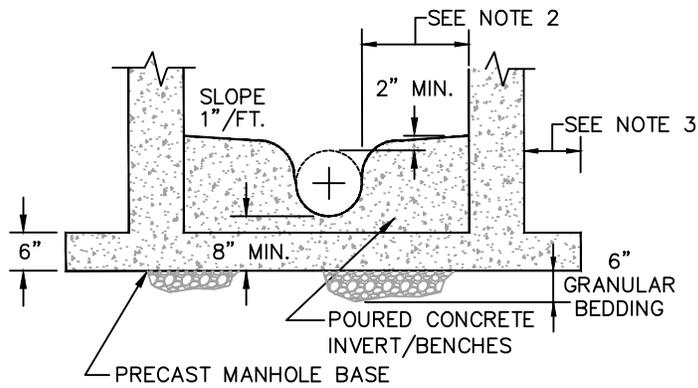


ALL CAST-IN-PLACE CONCRETE SHALL MEET REQUIREMENTS OF SECTION 02520.

NOTE: MINIMUM INSIDE DIAMETER OF PIPE MANHOLE SHALL BE AS FOLLOWS:

PIPE SIZE	MIN. MANHOLE DIAMETER
15" OR LESS	48"
18" TO 30"	60"
OVER 30"	72" OR GREATER*

*MINIMUM WIDTH OF BENCH AT WIDEST POINT SHALL BE 12"

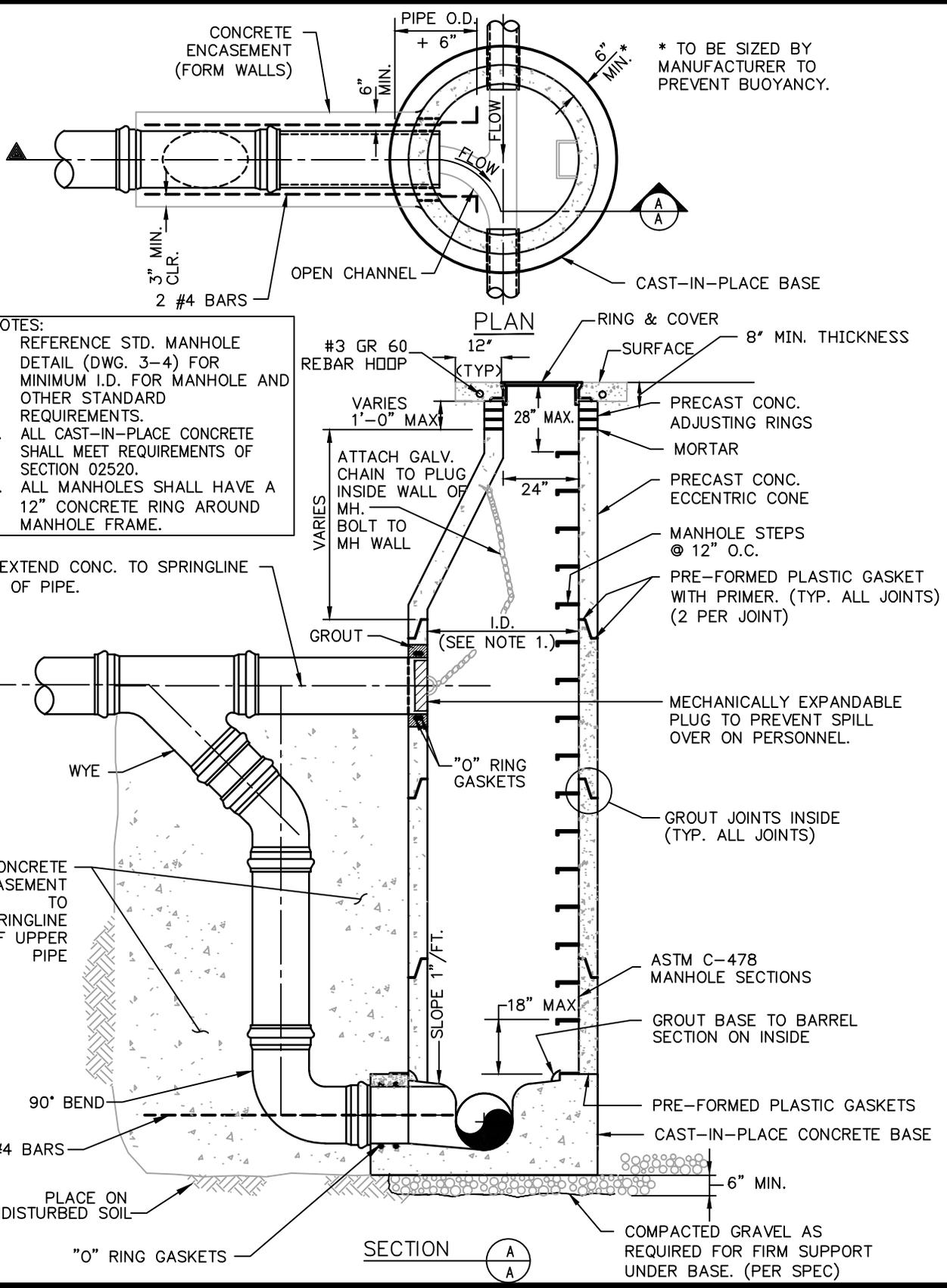


ALTERNATE BASE

- NOTE:**
1. ALL MANHOLES SHALL HAVE A 12" CONCENTRIC CONCRETE RING AROUND MANHOLE FRAME.
 2. MINIMUM WIDTH OF BENCH POINT SHALL BE 12".
 3. MANUFACTURER TO SIZE TO PREVENT BUOYANCY..

LATEST REV.	STANDARD MANHOLE (Sanitary & Storm)	DWG. REF.
March 2015	TOWN OF WELLINGTON, COLORADO	3-4

Plot Date: 3/3/2015 8:28 AM Plotted By: Bowen, Corey
 Date Created: 2/26/2015 V:\52873\FACTIVE\187310055\2014 DEVELOPMENT STANDARDS - UPDATED\STANDARD DETAILS 2014\AUTOCAD\DIV 3 SEWER DETAILS\DETAIL 3-5.DWG



- NOTES:**
1. REFERENCE STD. MANHOLE DETAIL (DWG. 3-4) FOR MINIMUM I.D. FOR MANHOLE AND OTHER STANDARD REQUIREMENTS.
 2. ALL CAST-IN-PLACE CONCRETE SHALL MEET REQUIREMENTS OF SECTION 02520.
 3. ALL MANHOLES SHALL HAVE A 12" CONCRETE RING AROUND MANHOLE FRAME.

* TO BE SIZED BY MANUFACTURER TO PREVENT BUOYANCY.

EXTEND CONC. TO SPRINGLINE OF PIPE.

CONCRETE ENCASEMENT TO SPRINGLINE OF UPPER PIPE

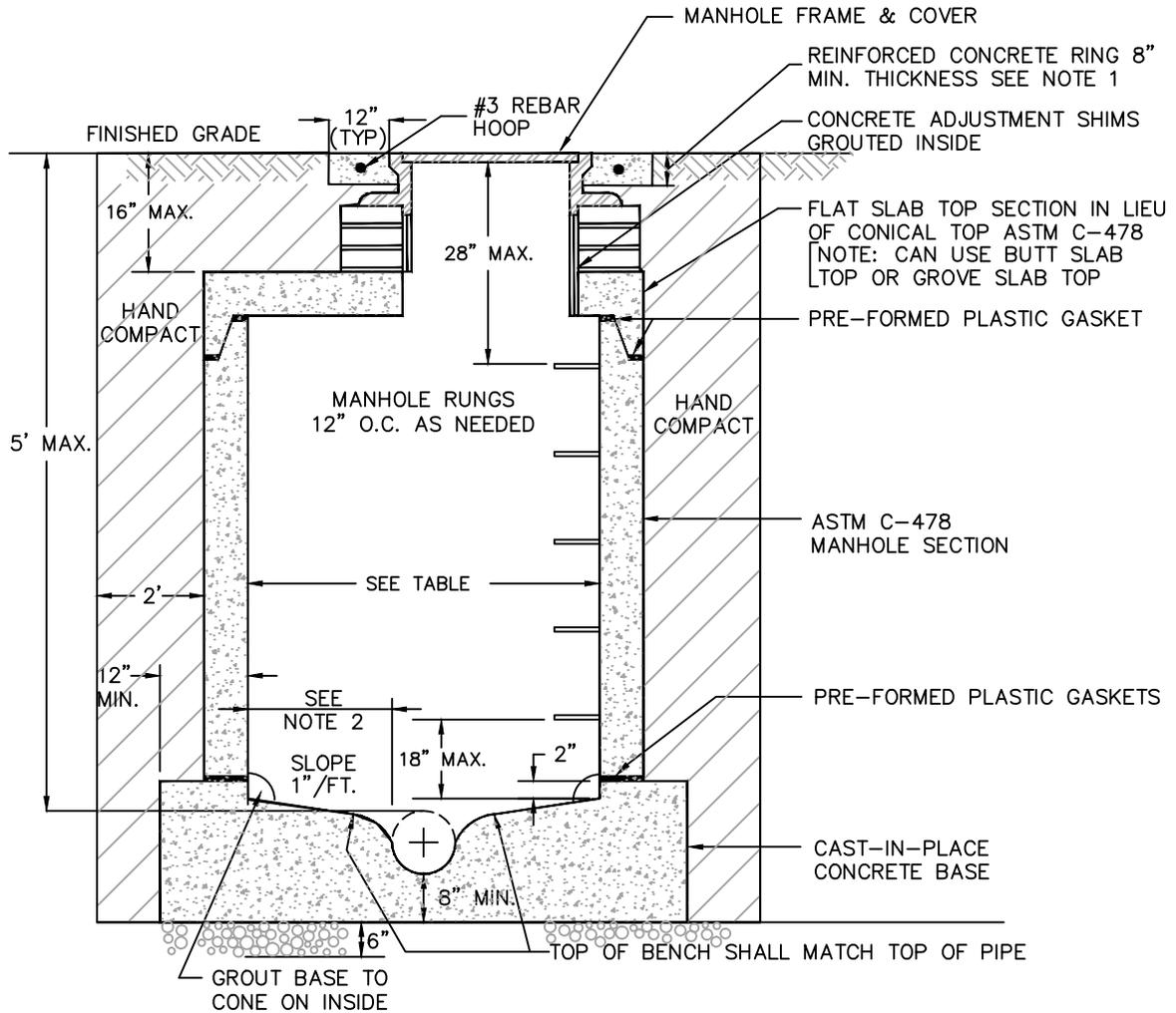
PLACE ON UNDISTURBED SOIL

"O" RING GASKETS

SECTION A-A

LATEST REV.	DROP MANHOLE	DWG. REF.
March 2015	TOWN OF WELLINGTON, COLORADO	3-5

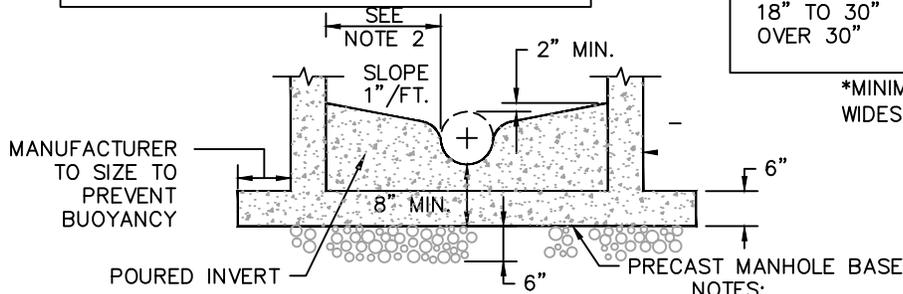
Plot Date: 3/3/2015 8:29 AM Plotted By: Bowen, Corey
 Date Created: 2/26/2015 V:\52873\FACTIVE\187310055\2014 DEVELOPMENT STANDARDS - UPDATED\STANDARD DETAILS 2014\AUTOCAD\DIV 3 SEWER DETAILS\DETAIL 3-6.DWG



NOTE:
 1. IF MANHOLE DEPTH IS LESS THAN 3 FEET, TOP SECTION SHALL HAVE A CONCENTRIC OPENING.
 2. ALL CAST-IN-PLACE CONCRETE SHALL MEET REQUIREMENTS OF SECTION 02520.

MINIMUM INSIDE DIAMETER OF MANHOLE SHALL BE AS FOLLOWS:	
PIPE SIZE	MIN. MANHOLE DIAMETER
15" OR LESS	48"
18" TO 30"	60"
OVER 30"	72" OR GREATER*

*MINIMUM WIDTH OF BENCH AT WIDEST POINT SHALL BE 12"



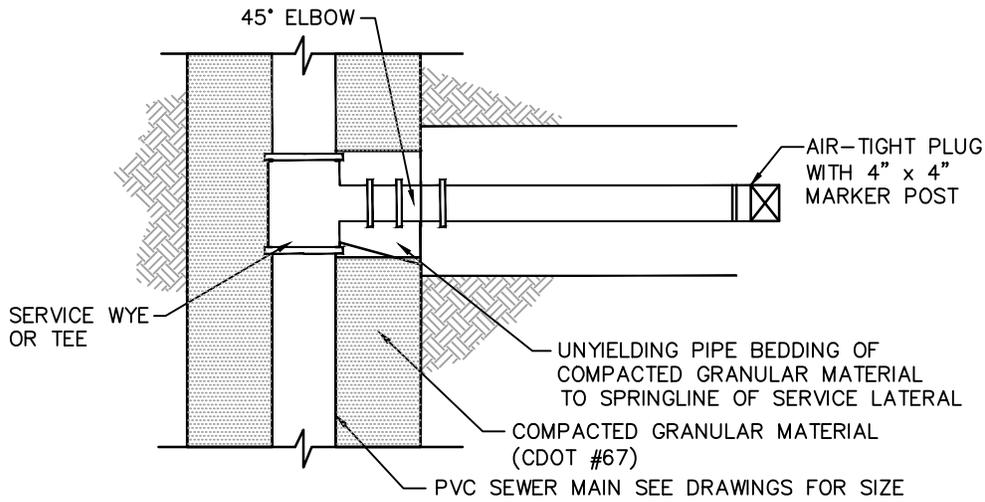
ALTERNATE BASE

NOTES:

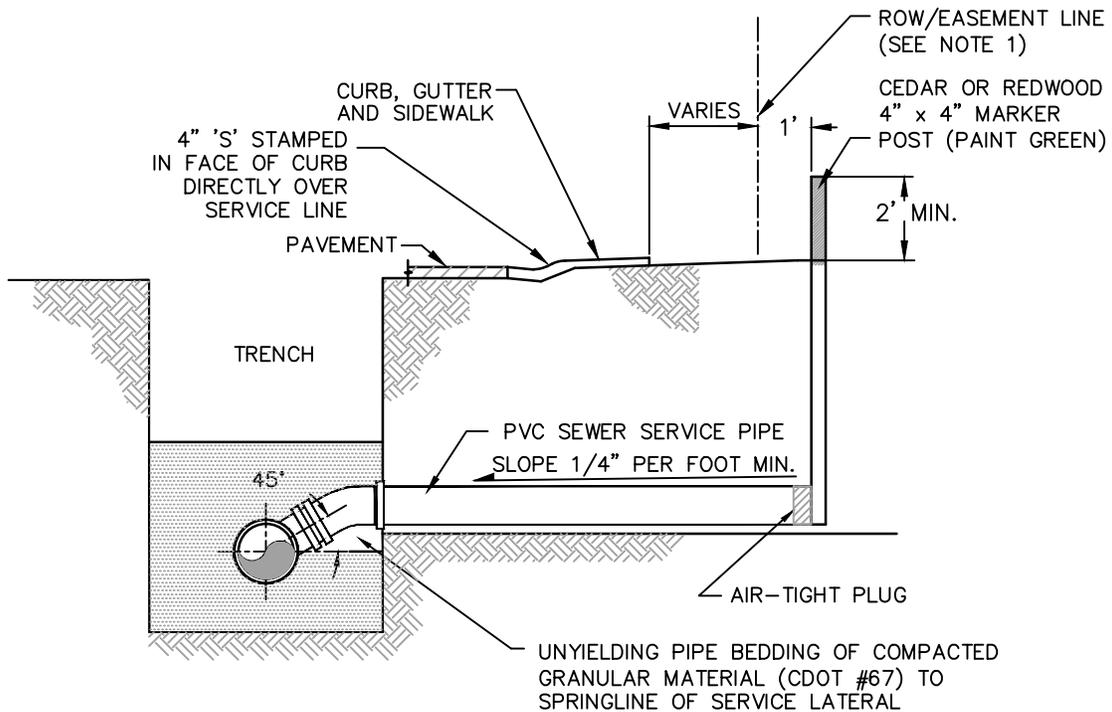
1. ALL MANHOLES SHALL HAVE A 12" CONCRETE RING AROUND MANHOLE FRAME.
2. MINIMUM WIDTH OF BENCH AT WIDEST POINT SHALL BE 12".
3. PLACE GRANULAR BEDDING FOR SUPPORT.

LATEST REV.	SHALLOW DEPTH MANHOLE WITH FLAT-TOP (SANITARY & STORM)	DWG. REF.
March 2015	TOWN OF WELLINGTON, COLORADO	3-6

Plot Date: 3/3/2015 8:31 AM Plotted By: Bowen, Corey
 Date Created: 2/26/2015 V:\52873\ACTIVE\187310055\2014 DEVELOPMENT STANDARDS - UPDATED\STANDARD DETAILS 2014\AUTOCAD\DIV 3 SEWER DETAILS\DETAIL 3-7.DWG



PLAN VIEW



CROSS SECTION

NOTES

1. SERVICE SHALL EXTEND 1' BEYOND THE ROW/EASEMENT LINE WHICHEVER IS FURTHER FROM BACK OF WALK..

LATEST REV.

SANITARY SEWER SERVICE WYE DETAIL

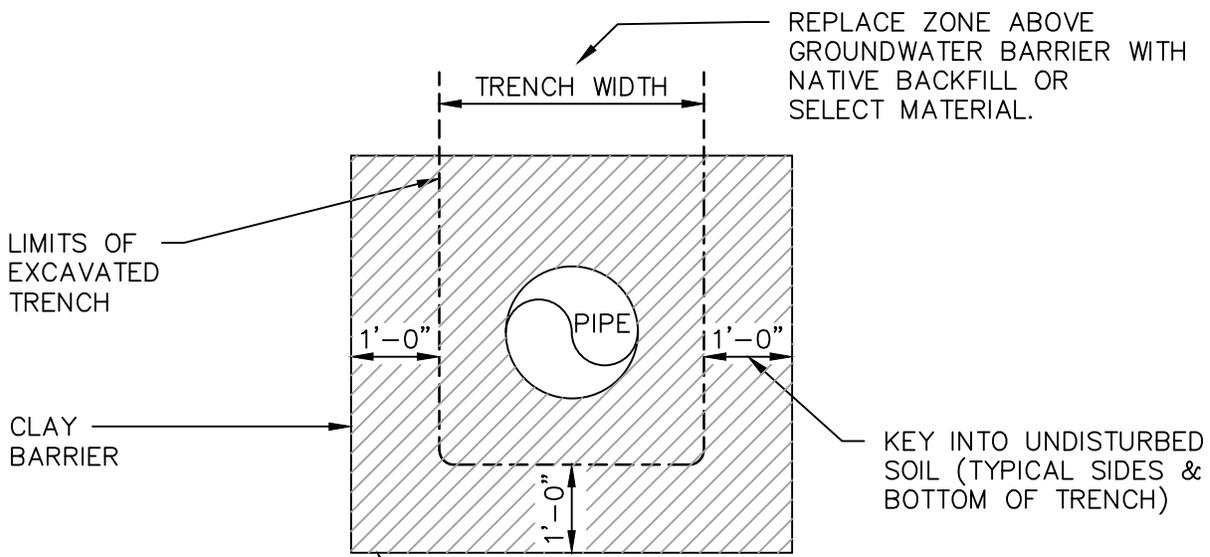
DWG. REF.

March 2015

TOWN OF WELLINGTON, COLORADO

3-7

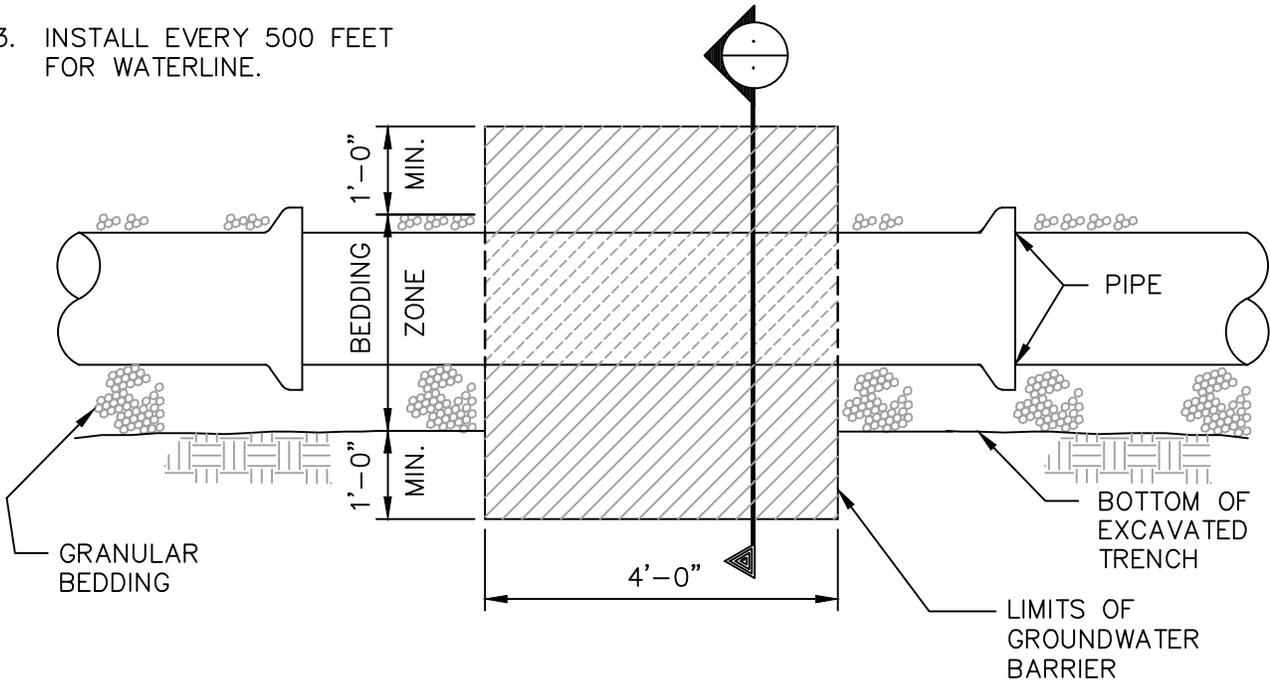
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 Date Created: 2/26/2015 V:\52873\FACTIVE\187310055\2014 DEVELOPMENT STANDARDS - UPDATED\STANDARD DETAILS 2014\AUTOCAD\DIV 3 SEWER DETAILS\DETAIL 3-8.DWG



NOTES:

1. GROUNDWATER BARRIER REQUIRED FOR ALL PIPE.
2. INSTALL 10-FT DOWNSTREAM OF ALL MANHOLES.
3. INSTALL EVERY 500 FEET FOR WATERLINE.

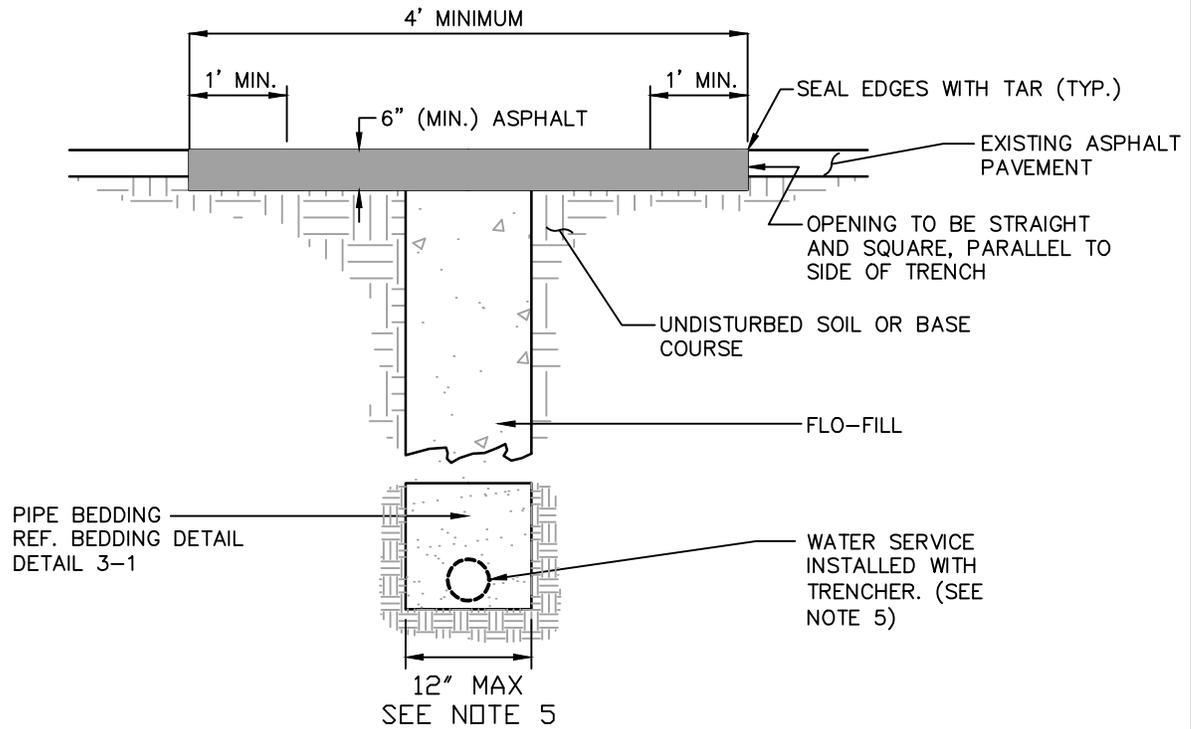
PROPOSED BOUNDARY OF GROUNDWATER BARRIER



ELEVATION

LATEST REV.	GROUNDWATER BARRIER DETAIL	DWG. REF.
March 2015	TOWN OF WELLINGTON, COLORADO	3-8

Plot Date: 3/3/2015 8:37 AM Plotted By: Bowen, Corey
 Date Created: 2/26/2015 V:\52873\ACTIVE\187310055\2014 DEVELOPMENT STANDARDS - UPDATED\STANDARD DETAILS 2014\AUTOCAD\DIV 3 SEWER DETAILS\DETAIL 3-10.DWG

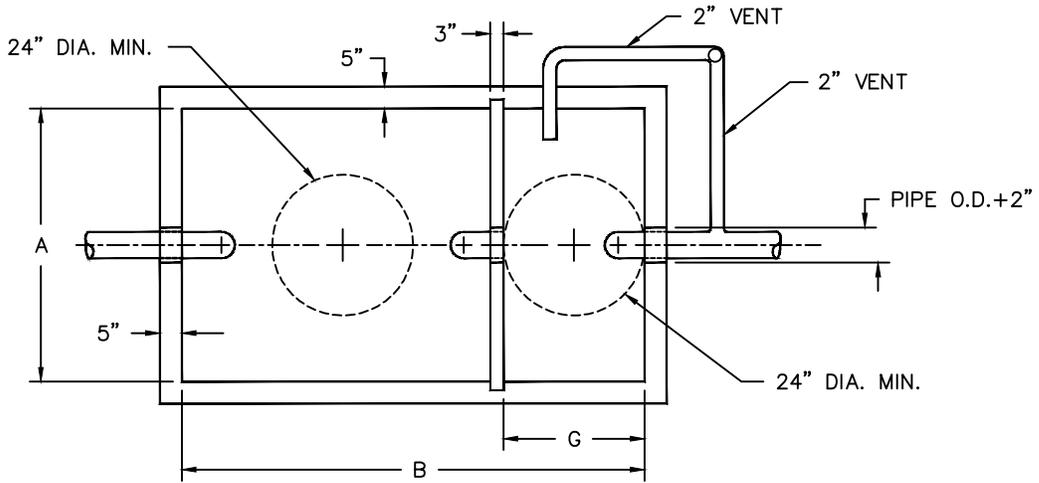


NOTES:

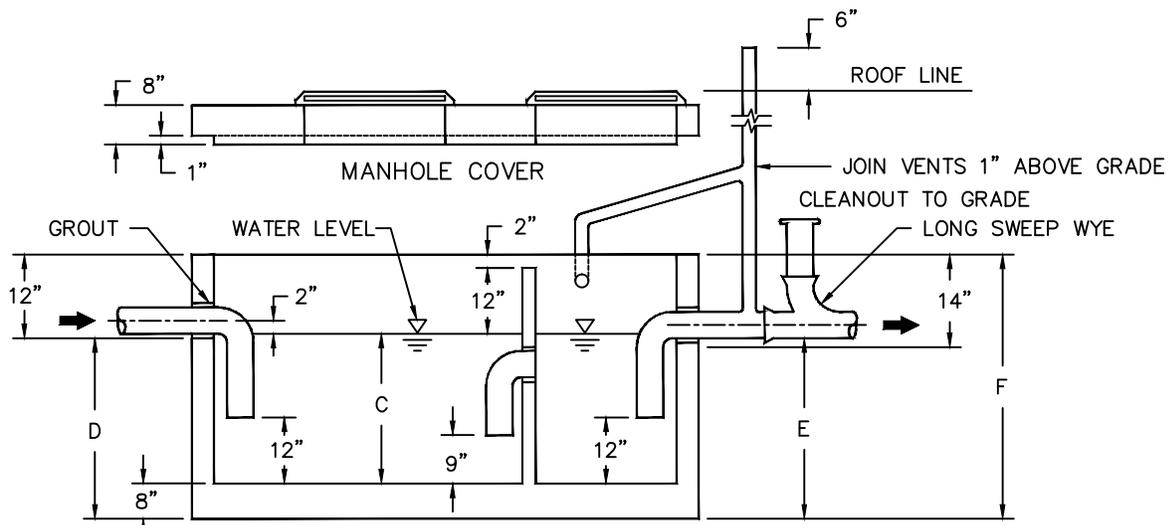
1. EXISTING PAVEMENT SHALL BE SAW OR WHEEL CUT TO OBTAIN A STRAIGHT AND NEAT EDGE FOR PAVING. SAW CUT SHALL BE MADE PRIOR TO PAVING AFTER BACKFILL TO BOTTOM OF NEW PAVEMENT.
2. PRIOR TO INSTALLATION OF PATCH, ALL EDGES OF EXISTING ASPHALT SHALL HAVE A TACK COAT APPLIED.
3. AFTER ALL ASPHALT HAS BEEN PLACED, ALL SEAMS BETWEEN NEW AND EXISTING PAVEMENT SHALL BE SEALED WITH AN ASPHALTIC TAR.
4. TOP OF NEW ASPHALT PAVEMENT SHALL MATCH THE TOP OF THE EXISTING PAVEMENT. ASPHALT PAVEMENT MINIMUM THICKNESS SHALL BE 6".
5. FLO-FILL TO EXTEND ALONG THE SERVICE TRENCH TO BACK OF WALK FOR REPLACEMENT SERVICES AND NEW SERVICES INSTALLED USING TRENCHER. SEE DETAIL 2-3 FOR EXCAVATED SERVICE TRENCHES.
6. REFERENCE SPECIFICATIONS SECTIONS 02221 & 02321.

LATEST REV.	REPLACING ASPHALTIC CONCRETE PAVEMENT FOR SEWER TRENCH	DWG. REF.
March 2014	TOWN OF WELLINGTON, COLORADO	3-10

Plot Date: 3/3/2015 8:38 AM Plotted By: Bowen, Corey
 Date Created: 2/26/2015 V:\52873\ACTIVE\187310055\2014 DEVELOPMENT STANDARDS - UPDATED\STANDARD DETAILS 2014\AUTOCAD\DIV 3 SEWER DETAILS\DETAIL 3-11.DWG



PLAN VIEW



SECTION VIEW

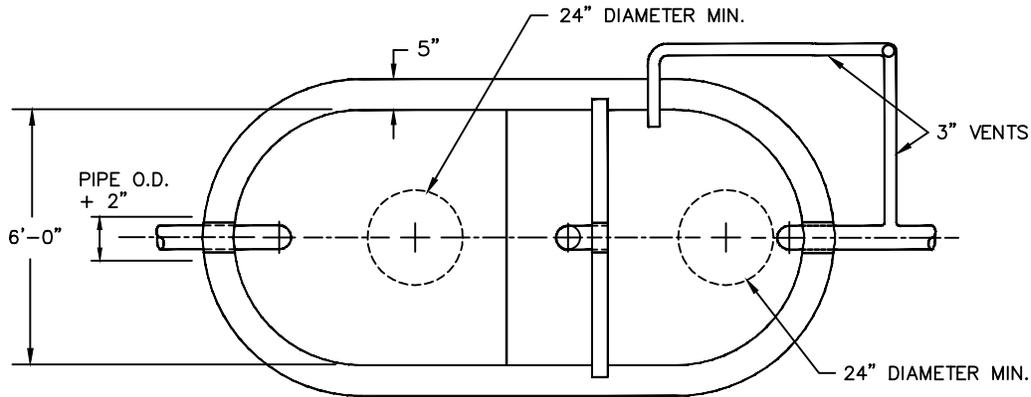
NOTES

1. SECONDARY COMPARTMENT HAS VOLUME EQUAL TO 1/3 OF TOTAL CAPACITY.
2. ALL PIPE AND FITTINGS TO BE CAST IRON, 3 INCH MINIMUM DIAMETER.
3. CLEAN OUT SHALL BE AN IRON BODY FERRULE WITH BRASS SCREW PLUG.
4. VENT PIPE SHALL BE CAST IRON TO A POINT 6" ABOVE GROUND.
5. CHECK WITH SUPPLIER FOR EXACT DIMENSIONS, AND REINFORCING TO ACCOMMODATE SITE CONDITIONS AND TRAFFIC LOADS.

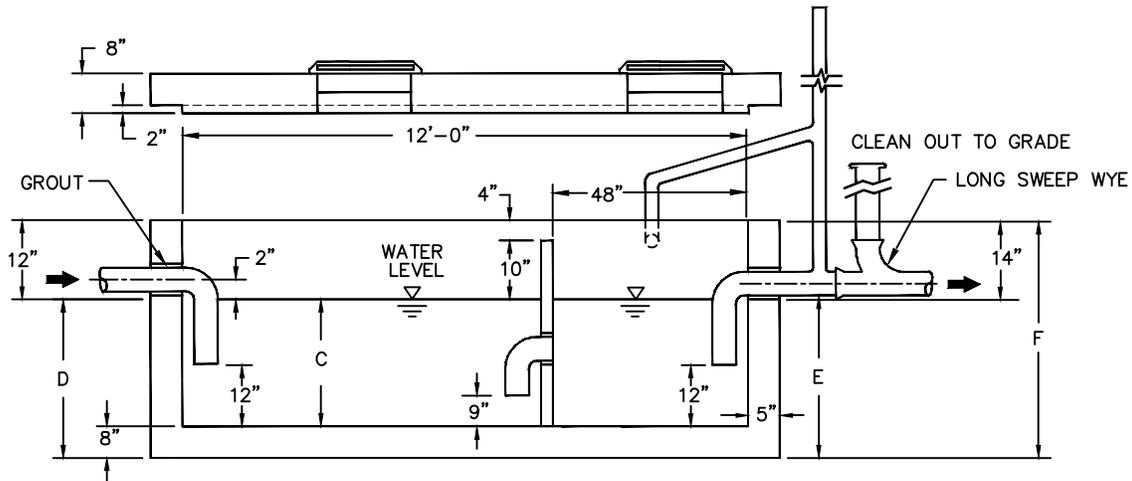
WATER CAPACITY APPROX. GALLONS	GREASE CAPACITY APPROX. CUBIC FT.	DIMENSIONS						
		TWO COMPARTMENT TANK INCHES						
		A	B	C	D	E	F	G
320	17	48	72	22	32	30	44	24
500	32	48	72	36	46	44	58	24
780	47	48	96	40	50	48	62	32
1060	74	72	102	34	44	42	56	34
1250	87	80	112	35	43	41	57	36

LATEST REV.	TYPE A GREASE INTERCEPTOR	DWG. REF.
March 2015	TOWN OF WELLINGTON, COLORADO	3-11

Plot Date: 3/3/2015 8:39 AM Plotted By: Bowen, Corey
 Date Created: 2/26/2015 V:\52873\FACTIVE\187310055\2014 DEVELOPMENT STANDARDS - UPDATED\STANDARD DETAILS 2014\AUTOCAD\DIV 3 SEWER DETAILS\DETAIL 3-12.DWG



PLAN VIEW



CROSS SECTION

NOTES:

1. SECONDARY COMPARTMENT HAS VOLUME EQUAL TO 1/3 OF TOTAL CAPACITY.
2. ALL PIPE AND FITTINGS TO BE CAST IRON, MIN. 3" DIAMETER.
3. WALLS AND BOTTOM REINFORCED THROUGHOUT WITH 2 x 16 6/10 REMESH.
4. COVERS TO BE REINFORCED LONGITUDINALLY WITH NO. 6 REBAR ON 6" CENTERS, NO. 4 REBAR ON 6" CENTERS WIDTHWISE, AND NO. 8 REBAR DIAGONALLY AROUND ACCESS HOLES.
5. CLEAN OUT SHALL BE IRON BODY FERRULE WITH BRASS SCREW PLUG.
6. VENT PIPE SHALL BE CAST IRON TO A POINT 6" ABOVE THE GROUND LEVEL.
7. GREASE CAPACITY RATED FOR LARGE COMPARTMENT ONLY.
8. CHECK WITH SUPPLIER FOR EXACT DIMENSIONS, AND REINFORCING TO ACCOMMODATE SITE CONDITIONS AND TRAFFIC LOADS.

WATER CAPACITY (APPROX) GALLONS	GREASE CAPACITY (APPROX) CU. FT.	DIMENSIONS (INCHES)			
		C	D	E	F
1565	100	40	50	48	62
1800	121	46	56	54	68
2035	143	52	62	60	74
2505	186	64	74	72	86
2975	229	76	86	84	98
3210	250	82	92	90	104
3445	271	88	98	96	110

LATEST REV.

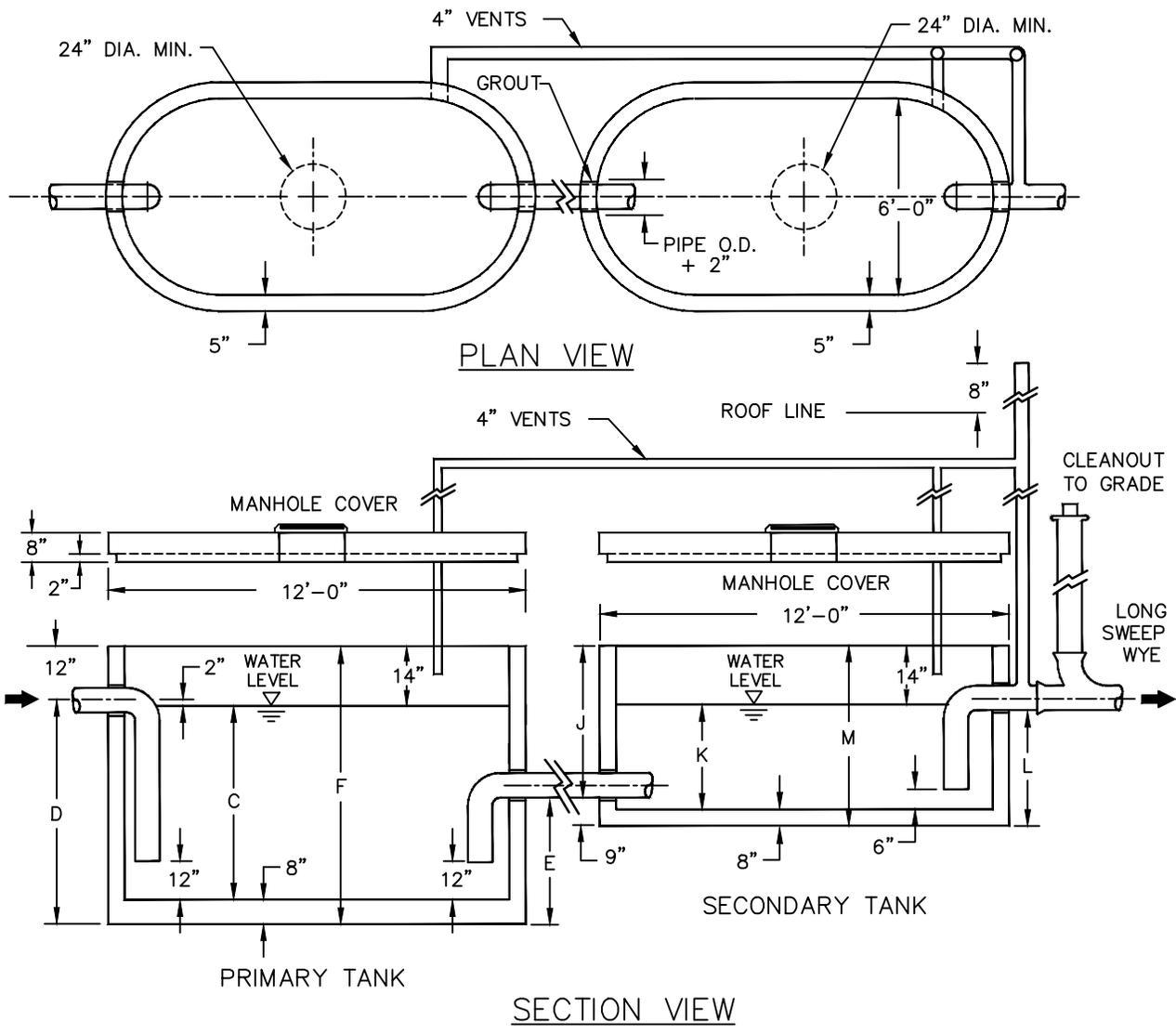
TYPE B GREASE INTERCEPTOR
 TOWN OF WELLINGTON, COLORADO

DWG. REF.

March 2015

3-12

Plot Date: 3/3/2015 8:40 AM Plotted By: Bowen, Corey Date Created: 2/26/2015 V:\52873\FACTIVE\187310055\2014 DEVELOPMENT STANDARDS - UPDATED\STANDARD DETAILS 2014\AUTOCAD\DIV 3 SEWER DETAILS\DETAIL 3-13.DWG



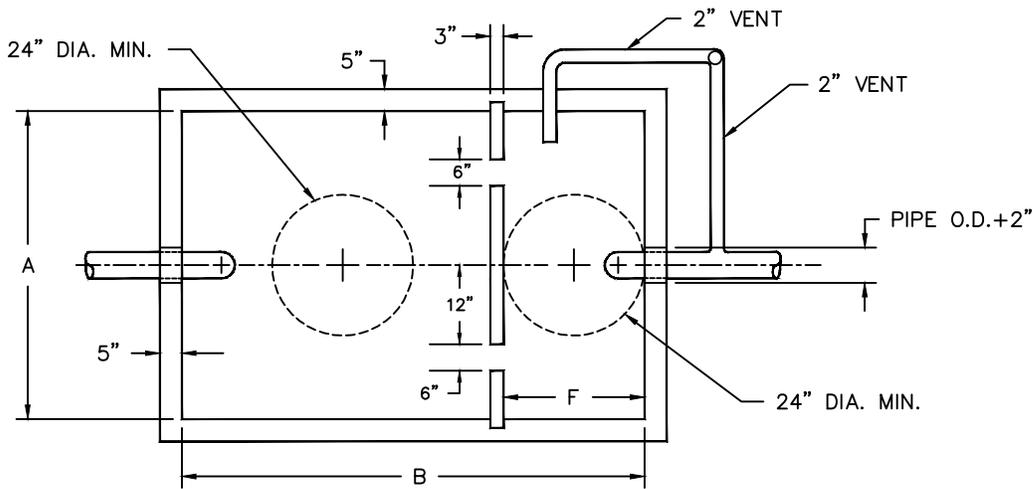
NOTES

1. SECONDARY COMPARTMENT HAS VOLUME EQUAL TO 1/3 OF TOTAL CAPACITY.
2. ALL PIPE AND FITTINGS TO BE CAST IRON, 3 INCH MINIMUM DIAMETER.
3. WALLS AND BOTTOM REINFORCED THROUGHOUT WITH 2 X 16 6/10 REMESH.
4. COVERS TO BE REINFORCED LONGITUDINALLY WITH NO. 6 REBAR ON 6" CENTERS, NO. 4 REBAR ON 6" CENTERS WIDTHWISE AND NO. 8 REBAR DIAGONALLY AROUND THE ACCESS HOLES.
5. CLEAN OUT SHALL BE AN IRON BODY FERRULE WITH BRASS SCREW PLUG.
6. VENT PIPE SHALL BE CAST IRON TO A POINT 6" ABOVE GROUND.
7. CHECK WITH SUPPLIER FOR EXACT DIMENSIONS, AND REINFORCING TO ACCOMMODATE SITE CONDITIONS AND TRAFFIC LOADS.

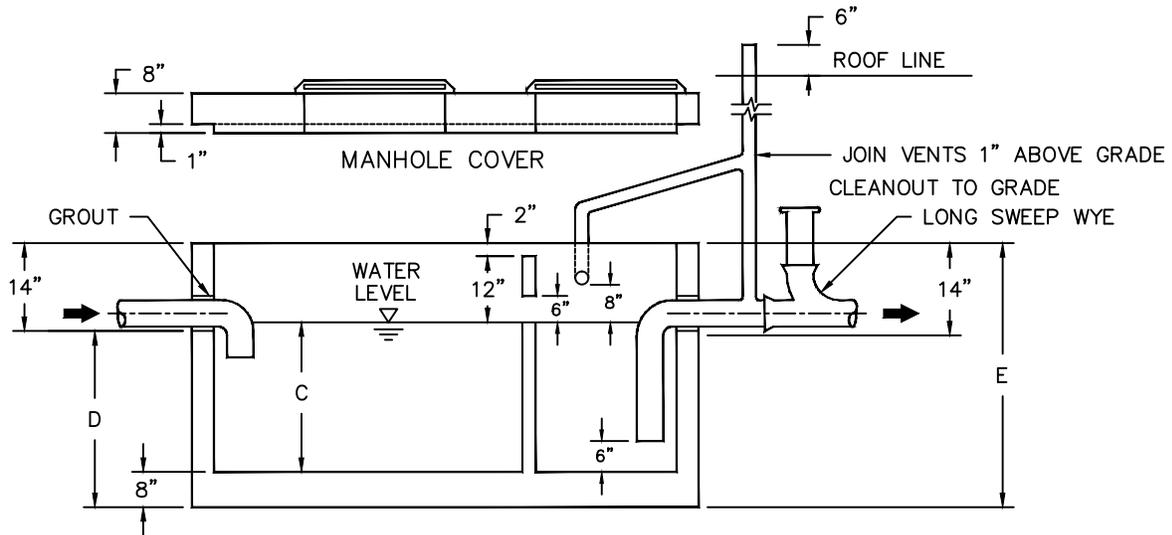
WATER CAPACITY (APPROX) GALLONS	GREASE CAPACITY (APPROX) CU. FT.	DIMENSIONS							
		PRIMARY				SECONDARY			
		(INCHES)							
		C	D	E	F	J	K	L	M
4160	311	70	80	45	92	47	34	42	56
4640	343	76	86	45	98	53	40	48	62
4860	375	82	92	51	104	53	40	48	62
5360	407	88	98	51	110	59	46	54	68
5600	439	94	104	57	116	59	46	54	68
6060	471	100	110	57	122	65	52	60	74

LATEST REV.	TYPE C GREASE INTERCEPTOR	DWG. REF.
March 2015	TOWN OF WELLINGTON, COLORADO	3-13

Plot Date: 3/3/2015 8:41 AM Plotted By: Bowen, Corey
 Date Created: 2/26/2015 V:\52873\FACTIVE\187310055\2014 DEVELOPMENT STANDARDS - UPDATED\STANDARD DETAILS 2014\AUTOCAD\DIV 3 SEWER DETAILS\DETAIL 3-14.DWG



PLAN VIEW



SECTION VIEW

NOTES

1. SECONDARY COMPARTMENT HAS VOLUME EQUAL TO 1/3 OF TOTAL CAPACITY.
2. ALL PIPE AND FITTINGS TO BE CAST IRON, 3 INCH MINIMUM DIAMETER.
3. WALLS AND BOTTOM REINFORCED THROUGHOUT WITH 2 X 16 6/10 REMESH.
4. COVERS TO BE REINFORCED LONGITUDINALLY WITH NO. 6 REBAR ON 6" CENTERS, NO. 4 REBAR ON 6" CENTERS WIDTHWISE AND NO. 8 REBAR DIAGONALLY AROUND THE ACCESS HOLES.
5. CLEAN OUT SHALL BE AN IRON BODY FERRULE WITH BRASS SCREW PLUG.
6. VENT PIPE SHALL BE CAST IRON TO A POINT 6" ABOVE GROUND.
7. CHECK WITH SUPPLIER FOR EXACT DIMENSIONS, AND REINFORCING TO ACCOMMODATE SITE CONDITIONS AND TRAFFIC LOADS.

WATER CAPACITY APPROX. GALLONS	DIMENSIONS					
	TWO COMPARTMENT TANK INCHES					
	A	B	C	D	E	F
320	48	72	22	30	44	24
500	48	72	36	44	58	24
780	48	96	40	48	62	32
1060	72	102	34	42	56	34

LATEST REV.

TYPE A SAND & OIL INTERCEPTOR

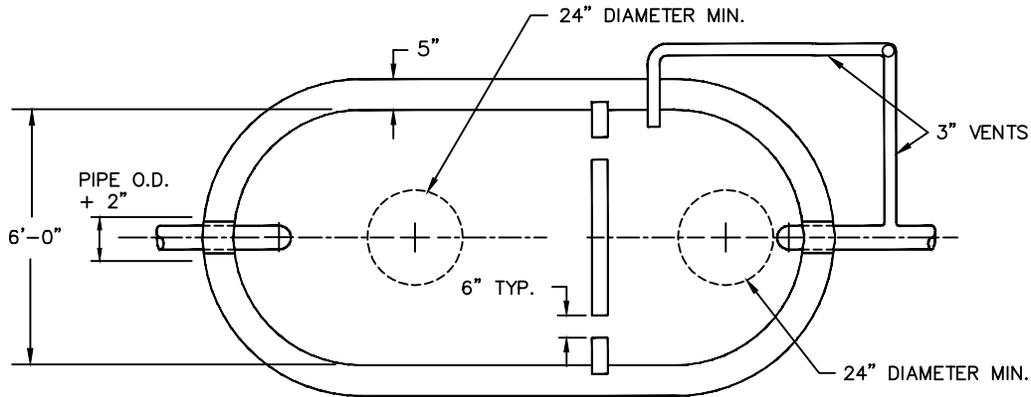
DWG. REF.

March 2015

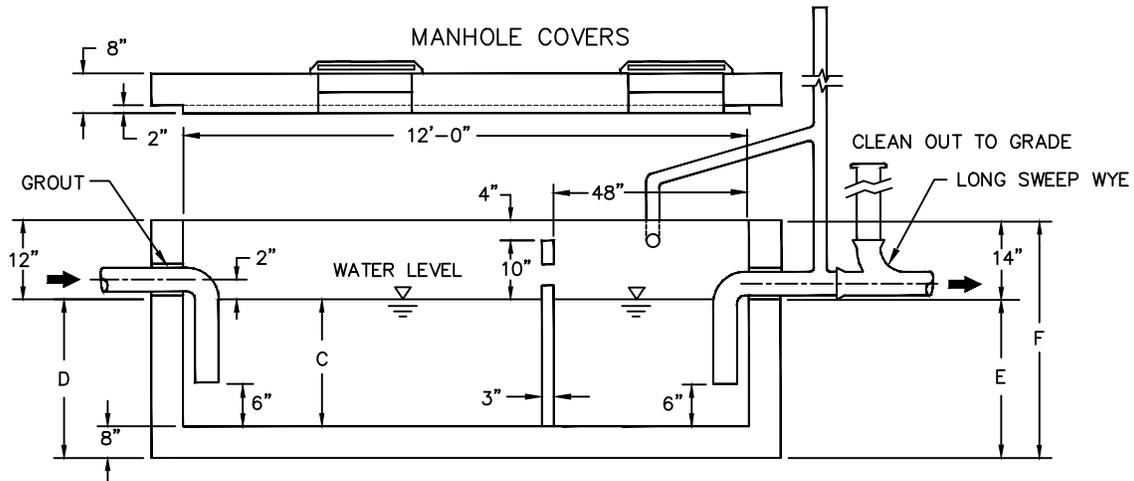
TOWN OF WELLINGTON, COLORADO

3-14

Plot Date: 3/3/2015 8:42 AM Plotted By: Bowen, Corey
 Date Created: 2/26/2015 V:\52873\FACTIVE\187310055\2014 DEVELOPMENT STANDARDS - UPDATED\STANDARD DETAILS 2014\AUTOCAD\DIV 3 SEWER DETAILS\DETAIL 3-15.DWG



PLAN VIEW



CROSS SECTION

NOTES:

1. SECONDARY COMPARTMENT HAS VOLUME EQUAL TO 1/3 OF TOTAL CAPACITY.
2. ALL PIPE AND FITTINGS TO BE CAST IRON, MIN. 3" DIAMETER.
3. WALLS AND BOTTOM REINFORCED THROUGHOUT WITH 2 x 16 6/10 REMESH.
4. COVERS TO BE REINFORCED LONGITUDINALLY WITH NO. 6 REBAR ON 6" CENTERS, NO. 4 REBAR ON 6" CENTERS WIDTHWISE, AND NO. 8 REBAR DIAGONALLY AROUND ACCESS HOLES.
5. CLEAN OUT SHALL BE IRON BODY FERRULE WITH BRASS SCREW PLUG.
6. VENT PIPE SHALL BE CAST IRON TO A POINT 6" ABOVE THE GROUND LEVEL.
7. CHECK WITH SUPPLIER FOR EXACT DIMENSIONS.

WATER CAPACITY (APPROX) GALLONS	DIMENSIONS (INCHES)			
	C	D	E	F
1565	40	50	48	62
1800	46	56	54	68
2035	52	62	60	74
2505	64	74	72	96
2975	76	86	84	98
3210	82	92	90	104
3445	88	98	96	110

LATEST REV.

TYPE B SAND & OIL INTERCEPTOR
TOWN OF WELLINGTON, COLORADO

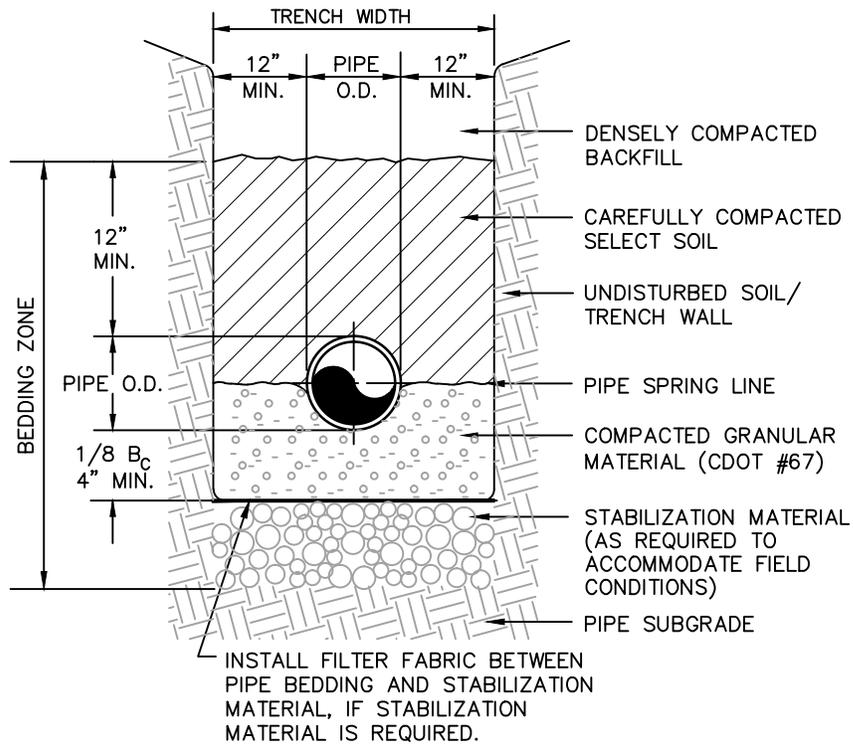
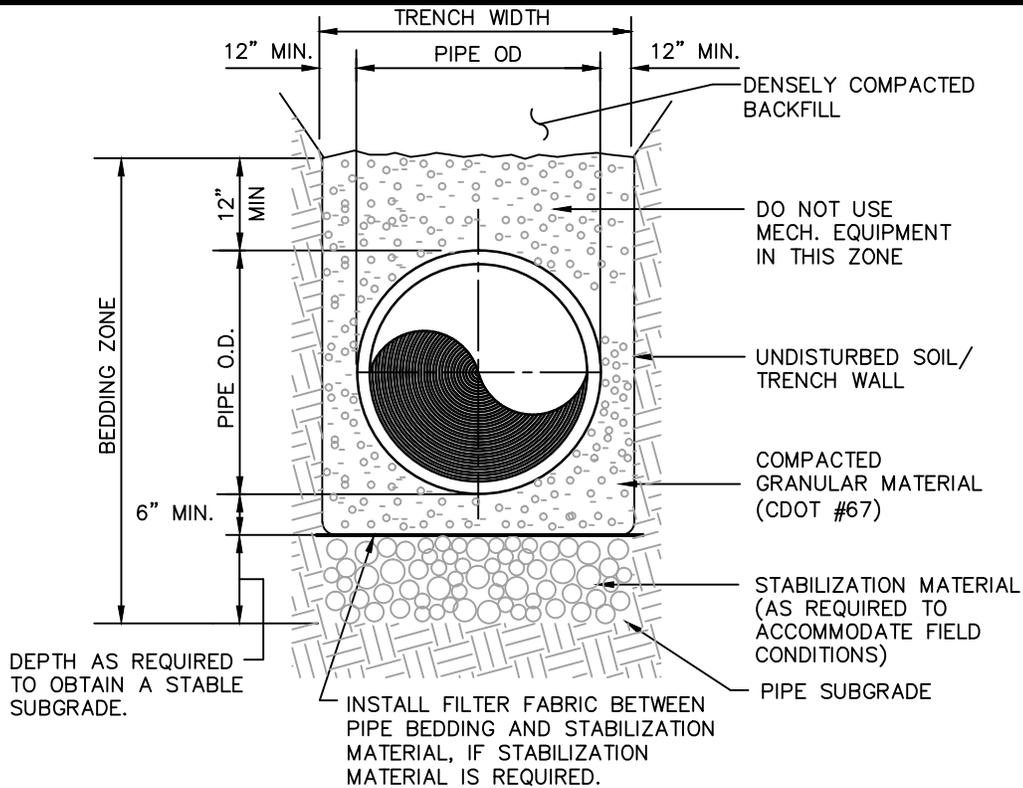
DWG. REF.

Nov 2014

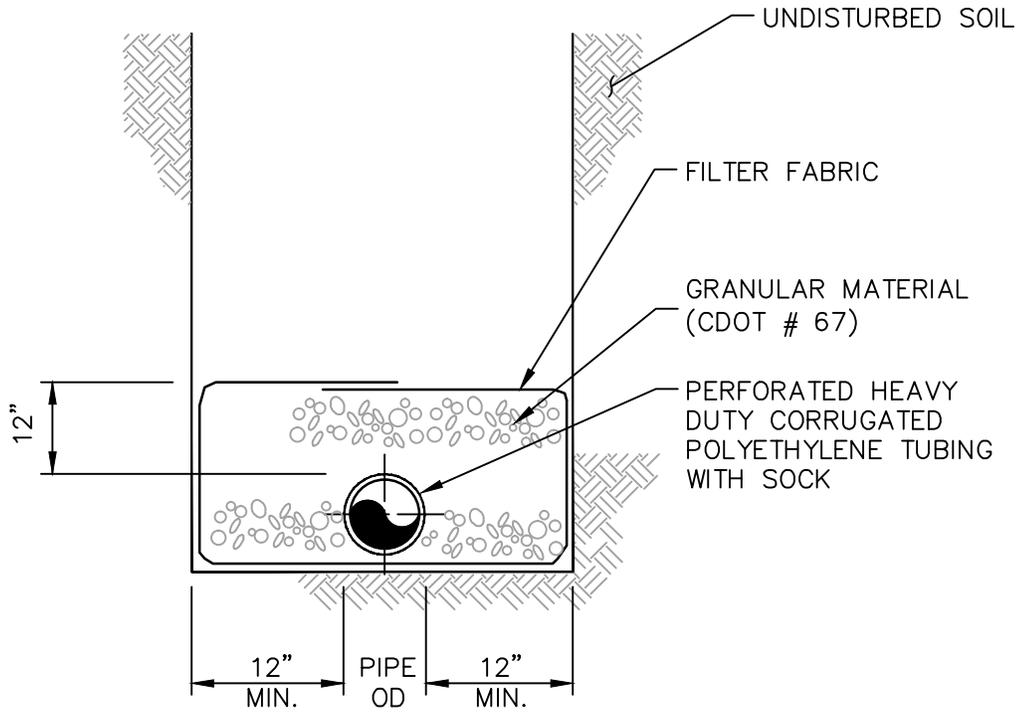
3-15

**DIVISION 4 –
STORM DRAINAGE**

Plot Date: 3/3/2015 8:43 AM Plotted By: Bowen, Corey Date Created: 2/27/2015 V:\52873\ACTIVE\187310055\2014 DEVELOPMENT STANDARDS - UPDATED\STANDARD DETAILS 4 DRAINAGE DETAILS\DETAIL 4-1.DWG



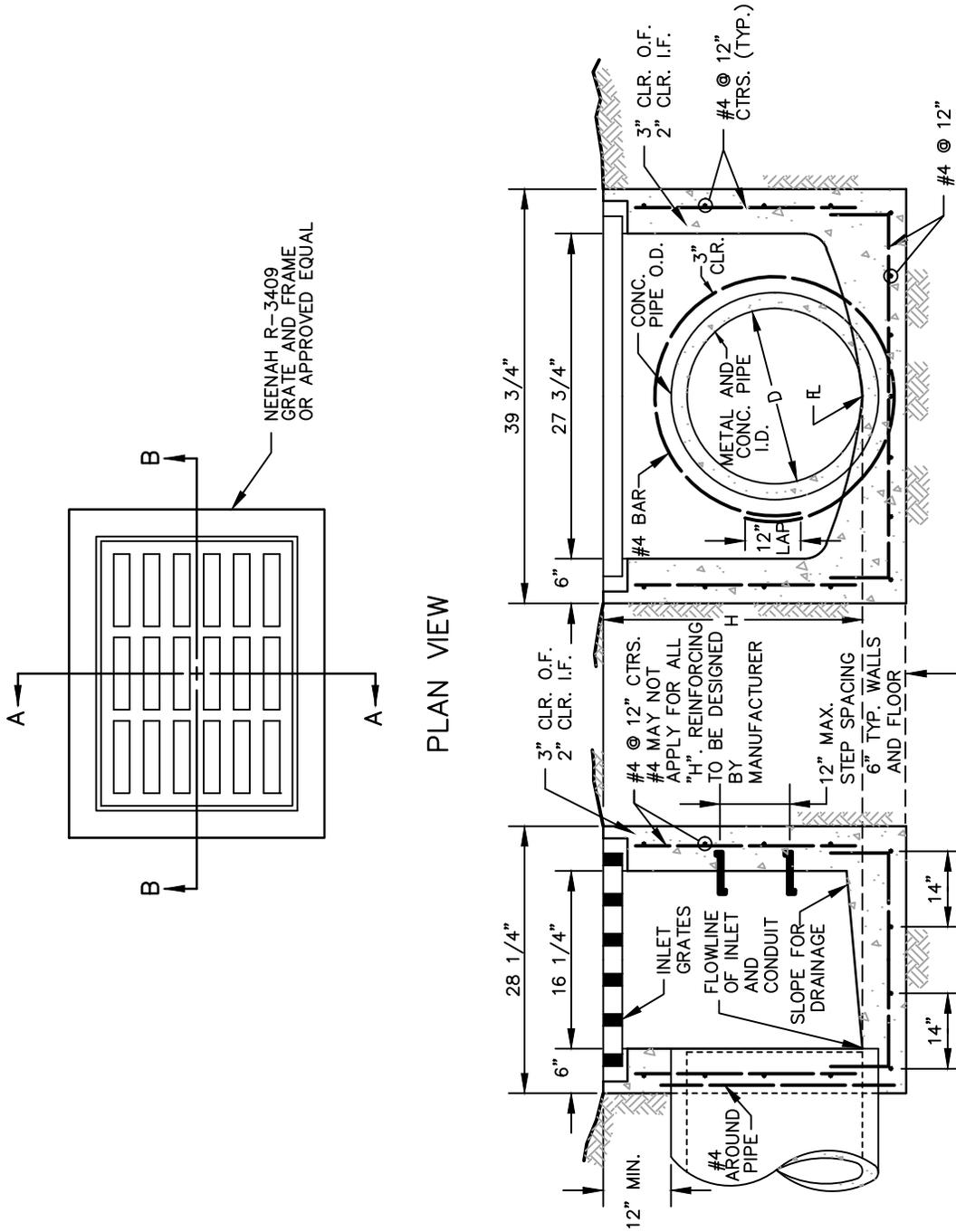
LATEST REV	BEDDING DETAIL – RCP, CMP, PLASTIC STORM DRAIN	DWG. REF.
March 2015	TOWN OF WELLINGTON, COLORADO	4-1



NOTE:

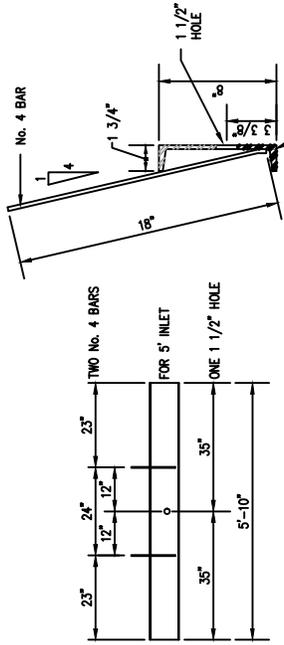
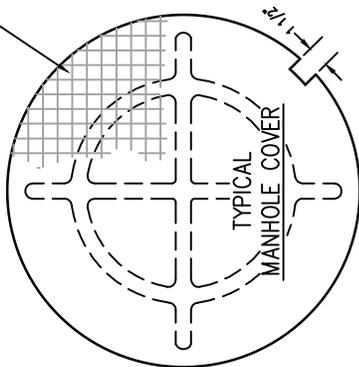
1. REFER TO BEDDING DETAIL FOR PLASTIC STORM DRAIN PIPE FOR BEDDING REQUIREMENTS.

LATEST REV.	UNDERDRAIN DETAIL – PLASTIC STORM DRAIN PIPE	DWG. REF.
March 2015	TOWN OF WELLINGTON, COLORADO	4-2



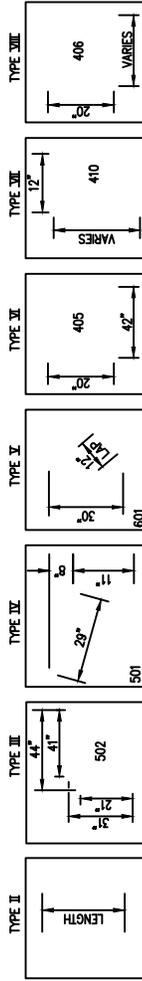
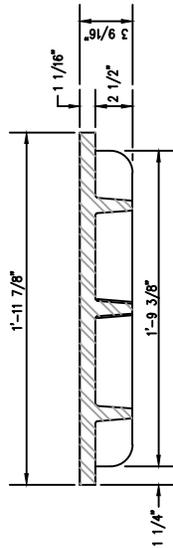
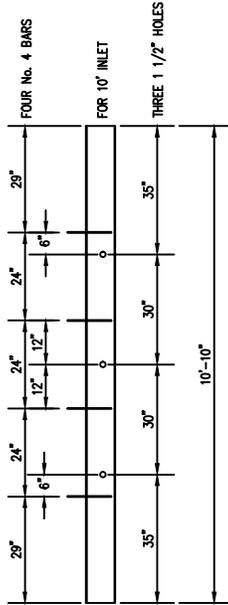
LATEST REV.	SUMP AREA INLET	DWG. REF.
March 2015	TOWN OF WELLINGTON, COLORADO	4-3

CHECKED
TOP DESIGN



GENERAL NOTES

1. ALL INLET QUANTITIES ARE LISTED FOR INFORMATION ONLY.
2. ALL CONCRETE SHALL BE CLASS A OR B.
3. CONCRETE WALLS SHALL BE FORMED ON BOTH SIDES AND SHALL BE 8" THICK.
4. CURB FACE ASSEMBLY SHALL BE GALVANIZED AFTER WELDING.
5. EXPOSED CONCRETE CORNERS SHALL BE REVEALED TO A 1 1/2" FACE. CURB AND GUTTER CORNERS SHALL BE FINISHED TO MATCH EXISTING CURB AND GUTTER BEYOND THE TRANSITION GUTTER.
6. ALL REINFORCING BARS SHALL BE TAGGED WITH BAR DESIGNATION.
7. REINFORCING BARS SHALL BE DEFORMED AND SHALL BE OF INTERMEDIATE GRADE STEEL.
8. DIMENSIONS AND WEIGHTS OF TYPICAL MANHOLE RING AND COVER ARE NOMINAL.
9. ALL BARS SHALL BE A MINIMUM 2" CLEAR.
10. SINCE PIPE ENTRIES INTO THE INLET ARE VARIABLE, THE DIMENSIONS SHOWN ARE TYPICAL. ACTUAL DIMENSIONS AND QUANTITIES FOR CONCRETE AND REINFORCEMENT SHALL BE AS REQUIRED IN THE WORK. QUANTITIES INCLUDE VOLUMES OCCUPIED BY PIPES.
11. STRUCTURAL STEEL SHALL BE GALVANIZED AND SHALL CONFORM TO THE REQUIREMENTS OF SECTION 509.



BAR BENDING DIAGRAMS ~ (DIMENSIONS ARE OUT-TO-OUT OF BAR)

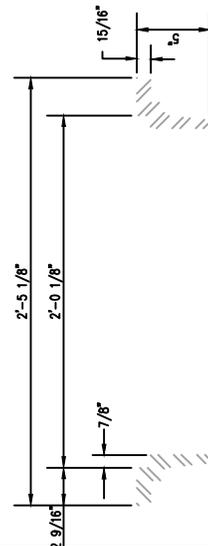
TABLE ONE ~ BAR LIST FOR CURB INLETS, TYPE R

MARK	DIA. In.	O.C. Spacing	TYPE	L = 5"		L = 10"		L = 15"	
				No. REQ'D	LENGTH	No. REQ'D	LENGTH	No. REQ'D	LENGTH
401	11"	I	15	*	21	*	26	*	
402	11"	II	7	*	13	*	18	*	
403	9"	II	*	4'-0"	*	4'-0"	*	4'-0"	
405	6"	III	11	6'-10"	21	6'-10"	31	6'-10"	
406	6"	III	7	6'-10"	7	13'-10"	7	18'-10"	
407	1/2"	IV	3	6'-10"	*	10'-0"	*	15'-0"	
408	6"	V	6	3'-10"	6	10'-0"	6	15'-0"	
410	11"	VI	*	*	*	*	*	*	
412	11"	VI	*	*	*	*	*	*	
413	9"	VI	*	*	*	*	*	*	
501	5/8"	VII	11	3'-4"	22	3'-4"	33	3'-4"	
502	5/16"	VII	5	3'-6"	16	3'-6"	27	3'-6"	
601	3/4"	VIII	2	8'-10"	2	8'-10"	2	8'-10"	
#8 @ 6.5	-	-	1	5'-10"	1	10'-10"	1	15'-10"	

TABLE TWO ~ BARS & QUANTITIES

H	LENGTH	L = 5"		L = 10"		L = 15"	
		No. Req'd	Reg'd	No. Req'd	Reg'd	No. Req'd	Reg'd
3'-0"	2'-8" 1'-8"	10	7	3.2	2.65	5.3	4.97
3'-6"	3'-2" 2'-2"	10	7	3.4	3.05	5.7	5.28
4'-0"	3'-6" 1'-6"	12	9	3.7	3.26	6.0	5.59
4'-6"	4'-2" 1'-2"	12	9	3.9	3.54	6.4	5.71
5'-0"	4'-6" 1'-6"	14	11	4.1	3.54	6.7	6.02

TYPICAL
MANHOLE RING



DWG. REF.

4-4

LATEST REV.

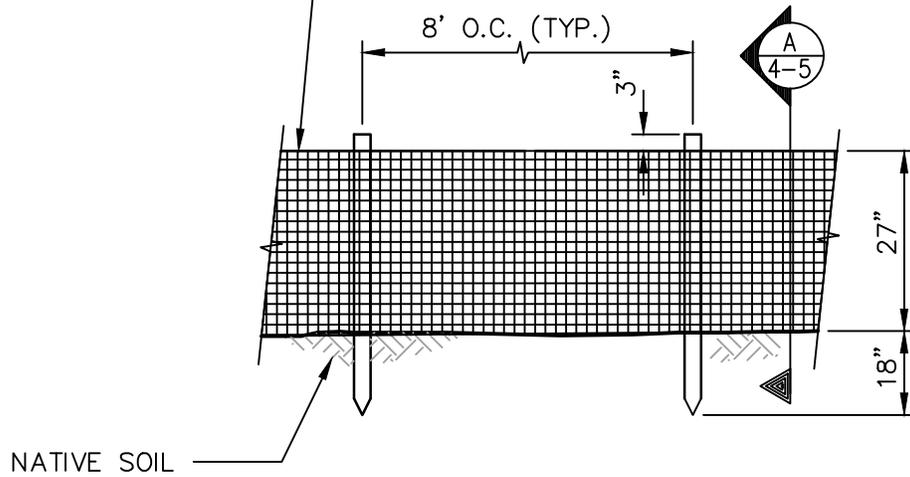
March 2015

TYPE R CURB INLET - SHEET 1 OF 3
TOWN OF WELLINGTON, COLORADO

* VARIABLE, REFER TO TABLE TWO
 † INCLUDE 16" No. 4 BARS (SEE CHANNEL LAYOUT DETAIL)
 ‡ SEE CURB FACE ASSEMBLY ON SHEET 1 AND CHANNEL LAYOUT DETAILS ON THIS SHEET.

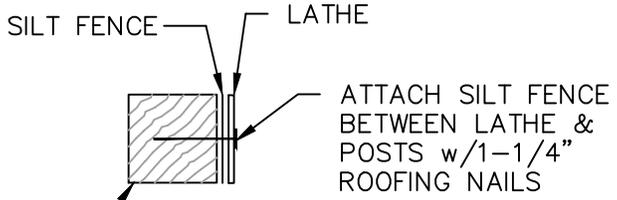
Plot Date: 3/3/2015 8:49 AM Plotted By: Bowen, Corey
 Date Created: 2/27/2015 V:\52873\ACTIVE\187310055\2014 DEVELOPMENT STANDARDS - UPDATED\STANDARD DETAILS 2014\AUTOCAD\DIV 4 DRAINAGE DETAILS\DETAIL 4-5.DWG

MIRAFI MODEL
10100 SILT FENCE



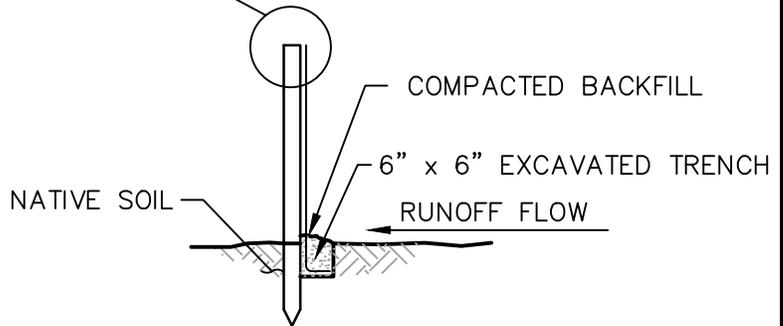
ELEVATION

NATIVE SOIL



DETAIL

1-1/2" SQUARE x 48" LONG,
KILN DRIED POSTS



SECTION

A
4-5

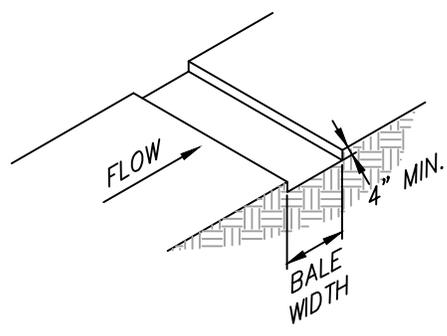
NOTE:

- INSPECT AND REPAIR FENCE AFTER EACH STORM EVENT. REMOVE SEDIMENT WHEN 6" OF THE HEIGHT OF THE FENCE HAS BEEN FILLED. REMOVED SEDIMENT SHALL BE PLACED IN TOPSOIL PILE.

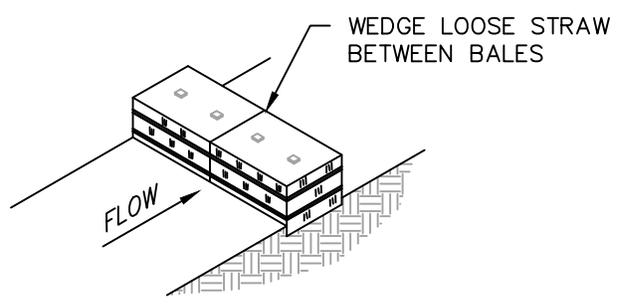
LATEST REV.	SEDIMENT CONTROL FENCE	DWG. REF.
March 2015	TOWN OF WELLINGTON, COLORADO	4-5

Plot Date: 3/3/2015 8:50 AM Plotted By: Bowen, Corey
 Date Created: 2/27/2015 V:\52873\FACTIVE\187310055\2014 DEVELOPMENT STANDARDS - UPDATED\STANDARD DETAILS 2014\AUTOCAD\DIV 4 DRAINAGE DETAILS\DETAIL 4-6.DWG

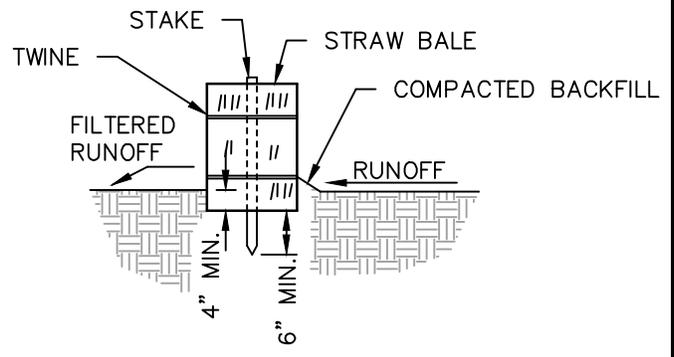
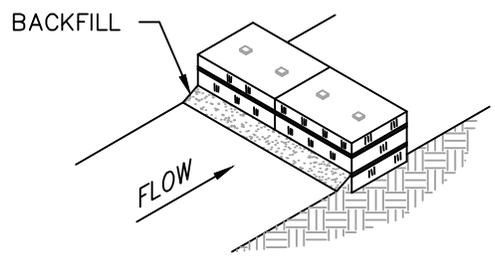
1. EXCAVATE TRENCH,
4" MINIMUM DEPTH



2. PLACE AND STAKE STRAW BALES



3. BACKFILL AND COMPACT EXCAVATED SOIL



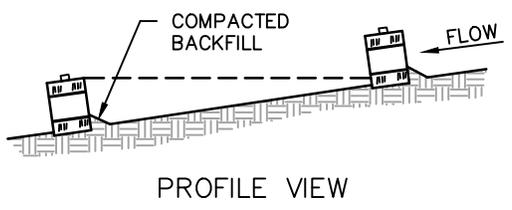
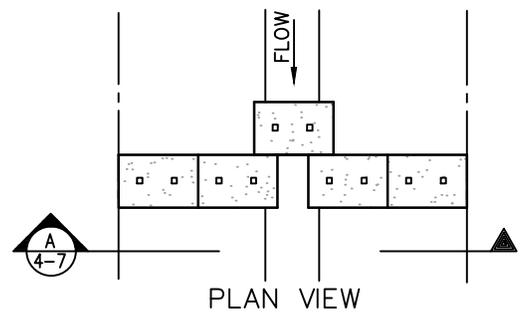
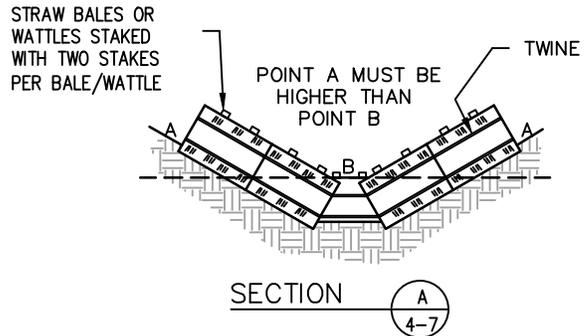
CROSS-SECTION VIEW

GENERAL NOTES:

1. WHEN USED AS A CONTINUOUS PERIMETER FILTER BARRIER THE MAXIMUM TRIBUTARY AREA IS LIMITED TO 0.25 ACRES PER 100 FEET OF BARRIER.
2. INSPECT, REPAIR, AND REPLACE (IF NECESSARY) THE FILTERS AFTER EACH STORM EVENT.
3. ALL BALES MUST BE REPLACED AFTER 12 MONTHS UNLESS APPROVAL IS GRANTED BY THE TOWN FOR LONGER USE.
3. WATTLES MAY BE USED IN PLACE OF STRAW BALES.

LATEST REV.	SEDIMENT COLLECTION BARRIER	DWG. REF.
March 2015	TOWN OF WELLINGTON, COLORADO	4-6

Plot Date: 3/3/2015 8:50 AM Plotted By: Bowen, Corey
 Date Created: 2/27/2015 V:\52873\FACTIVE\187310055\2014 DEVELOPMENT STANDARDS - UPDATED\STANDARD DETAILS 2014\AUTOCAD\DIV 4 DRAINAGE DETAILS\DETAIL 4-7.DWG

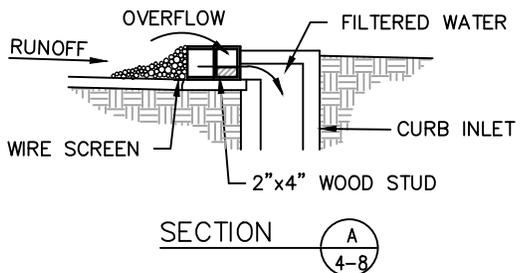
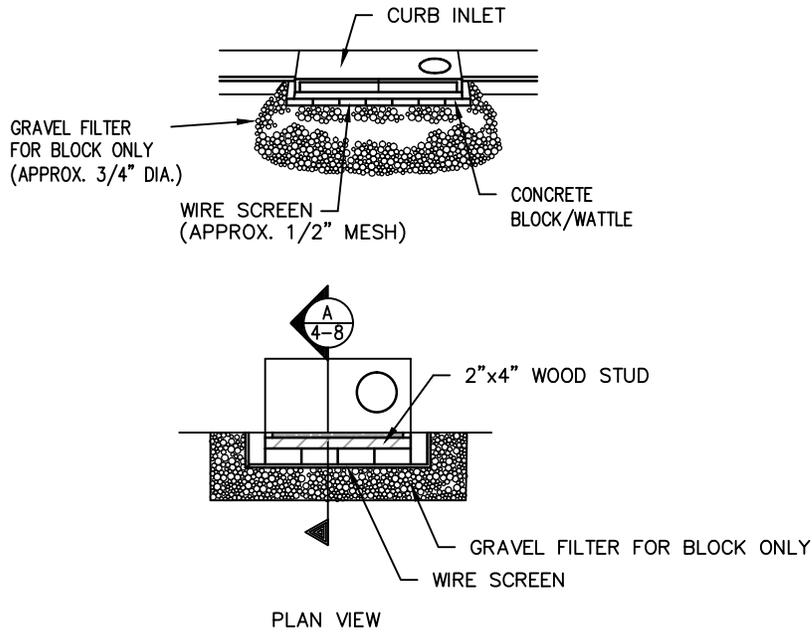


GENERAL NOTES:

1. INSPECT, REPAIR, AND REPLACE, (IF NECESSARY) THE FILTERS AFTER EACH STORM EVENT.
2. ALL BALES MUST BE REPLACED AFTER 12 MONTHS UNLESS APPROVAL IS GRANTED BY THE TOWN FOR LONGER USE.
3. WATTLES MAY BE USED IN PLACE OF STRAW BALES.

LATEST REV.	EROSION CHECK DAM	DWG. REF.
March 2015	TOWN OF WELLINGTON, COLORADO	4-7

Plot Date: 3/3/2015 8:51 AM Plotted By: Bowen, Corey
 Date Created: 2/27/2015 V:\52873\ACTIVE\187310055\2014 DEVELOPMENT STANDARDS - UPDATED\STANDARD DETAILS 4 DRAINAGE DETAILS\DETAIL 4-8.DWG

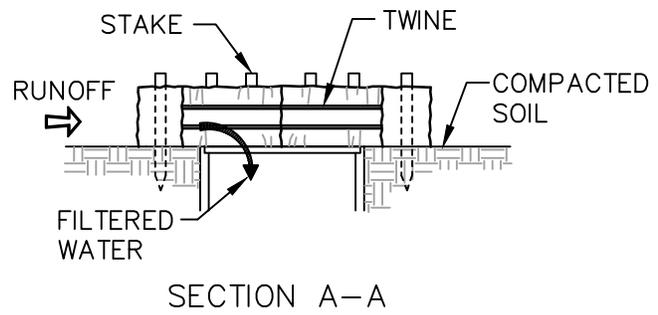
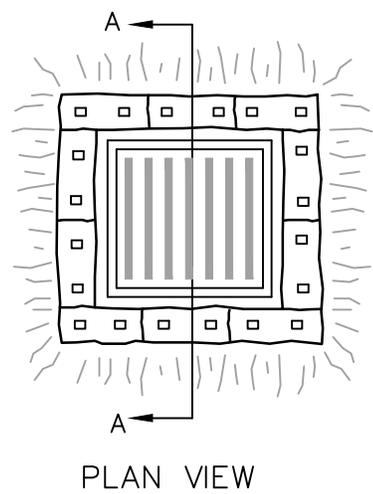
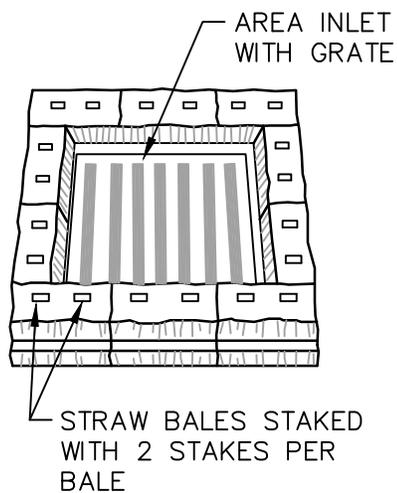


GENERAL NOTES:

1. INSPECT AND REPAIR FILTERS AFTER EACH STORM EVENT. REMOVE SEDIMENT WHEN ONE HALF OF THE FILTER DEPTH HAS BEEN FILLED. REMOVED SEDIMENT SHALL BE DEPOSITED IN AN AREA TRIBUTARY TO A SEDIMENT BASIN OR OTHER FILTERING MEASURE.
2. SEDIMENT AND GRAVEL SHALL BE IMMEDIATELY REMOVED FROM TRAVELED ROADS.
3. WATTLES MAY BE USED IN PLACE OF BLOCK. WATTLE MUST COVER THE OPEN LENGTH OF THE INLET.

LATEST REV.	EROSION CONTROL CURB INLET FILTER	DWG. REF.
March 2015	TOWN OF WELLINGTON, COLORADO	4-8

Plot Date: 3/3/2015 8:52 AM Plotted By: Bowen, Corey
 Date Created: 2/27/2015 V:\52873\FACTIVE\187310055\2014 DEVELOPMENT STANDARDS - UPDATED\STANDARD DETAILS 2014\AUTOCAD\DIV 4 DRAINAGE DETAILS\DETAIL 4-9.DWG



GENERAL NOTES

1. WEDGE LOOSE STRAW BETWEEN THE STAKED BALES.
2. INSPECT AND REPAIR FILTERS AFTER EACH STORM EVENT. REMOVE SEDIMENT WHEN ONE HALF OF THE FILTER DEPTH HAS BEEN FILLED. REMOVED SEDIMENT SHALL BE DEPOSITED IN AN AREA TRIBUTARY TO A SEDIMENT BASIN OR OTHER FILTERING MEASURE.
3. SEDIMENT SHALL BE REMOVED IMMEDIATELY FROM TRAVELED WAY OF ROADS.
4. WATTLES MAY BE USED IN PLACE OF STRAW BALES.

LATEST REV.	AREA INLET FILTER	DWG. REF.
March 2015	TOWN OF WELLINGTON, COLORADO	4-9

CLASSIFICATION AND GRADATION OF ORDINARY RIPRAP

RIPRAP DESIGNATION	% SMALLER THAN GIVEN SIZE BY WEIGHT	INTERMEDIATE DIMENSION (IN POUNDS)	d ₅₀ * (INCHES)
TYPE VL	70-100	12	6**
	50-70	9	
	35-50	6	
	2-10	2	
TYPE L	70-100	15	9**
	50-70	12	
	35-50	9	
	2-10	3	
TYPE M	70-100	21	12
	50-70	18	
	35-50	12	
	2-10	4	
TYPE H	100	30	18
	50-70	24	
	35-50	18	
	2-10	6	
TYPE VH	100	42	24
	50-70	33	
	35-50	24	
	2-10	9	

d₅₀*=MEAN PARTICLE SIZE. AT LEAST 50 PERCENT OF THE MASS SHALL BE STONES EQUAL TO OR LARGER THAN THIS DIMENSION.

** BURY ON 4 TO 1 SIDE SLOPES OR GROUT ROCK IF SLOPES ARE STEEPER.

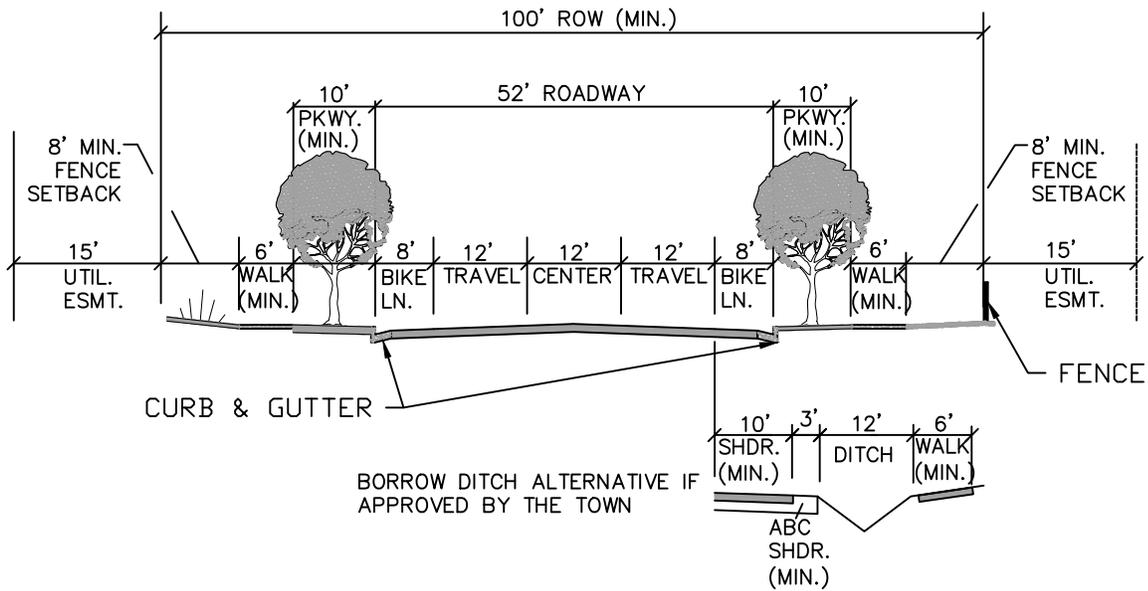
GRADATION FOR FILTER MATERIAL UNDER RIPRAP

SIEVE SIZE	% BY WEIGHT PASSING SQUARE MESH SIEVES	
	TYPE I (CDOT CONCRETE SAND SPECIFICATION (AASHTO M6) SECTION 703.01)	TYPE II (CDOT CLASS A, SECTION 703.09)
3"	....	90-100
1-1/2"	....	....
3/4"	....	20-90
3/8"	100	....
#4	95-100	0-20
#16	45-80	....
#50	10-30	....
#100	2-10	....
#200	0-2	0-3

LATEST REV.	RIP-RAP GRADATION & BEDDING GRADATION TABLE	DWG. REF.
March 2015	TOWN OF WELLINGTON, COLORADO	4-10

DIVISION 5 –
STREETS

Plot Date: 3/3/2015 8:54 AM Plotted By: Bowen, Corey
 Date Created: 2/27/2015 V:\52873\FACTIVE\187310055\2014 DEVELOPMENT STANDARDS - UPDATED\STANDARD DETAILS 2014\AUTOCAD\DIV 5 STREETS DETAILS\DETAIL 5-1.DWG



ROADWAY WIDTH: 52'

RIGHT OF WAY WIDTH: 100' (MIN.) PLUS 30' (MIN.) UTILITY EASEMENT.

TRAVEL LANES: TWO LANES, 12' WIDE.

LEFT TURN LANES: 12' WIDE AT INTERSECTIONS WHERE NEEDED.

BIKE LANES: TWO LANES, 8' WIDE.

PARKING: NONE

PARKWAY: 10' (MIN.) WIDTH. ADDITIONAL WIDTH OPTIONAL.

SIDEWALK: 6' (MIN.) WIDE. ADDITIONAL WIDTH MAY BE REQUIRED FOR HIGHER PEDESTRIAN TRAFFIC IN AND LEADING TO ACTIVITY AREAS. IF SIDEWALK IS OMITTED, TOWN APPROVAL IS REQUIRED.

MEDIAN: IF MEDIANS ARE PROPOSED THEY MUST BE ACCEPTABLE TO THE TOWN.

WHERE USED: THESE SPECIFICATIONS SHALL APPLY AS REQUIRED BY WELLINGTON WHEN AN ARTERIAL STREET IS SHOWN ON THE MASTER STREET PLAN OR WHEN THE TRAFFIC VOLUME ON THE STREET IS ANTICIPATED TO BE 3,500 TO 15,000 VPD.

DESIGN SPEED: 50 MPH

SPEED LIMIT: 30 - 45 MPH

ACCESS: ACCESS WILL BE LIMITED. POINTS OF ACCESS MUST BE APPROVED BY THE TOWN OF WELLINGTON.

CONTINUITY: UNLIMITED

FENCES: FENCES SHALL BE SETBACK A MINIMUM OF 8' FROM THE BACK EDGE OF THE SIDEWALK.

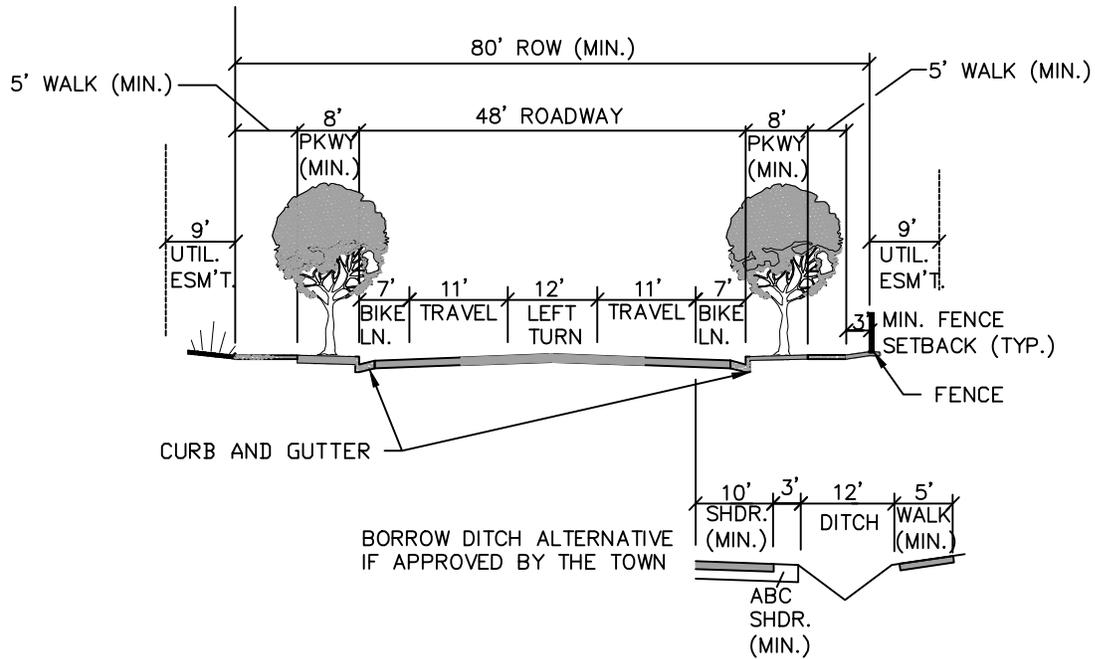
CURB AND GUTTER: VERTICAL OR BORROW DITCHES IF APPROVED BY THE TOWN.

STRIPING: AS SHOWN ON STRIPING PLAN TO BE APPROVED BY TOWN.

STREET TREES: AS SHOWN ON LANDSCAPING PLAN TO BE APPROVED BY TOWN. REQUIRED SPACING IS 40' O.C.

LATEST REV.	ARTERIAL STREET	DWG. REF.
March 2015	TOWN OF WELLINGTON, COLORADO	5-1

Plot Date: 3/3/2015 8:55 AM Plotted By: Bowen, Corey
 Date Created: 2/27/2015 V:\52873\FACTIVE\187310055\2014 DEVELOPMENT STANDARDS - UPDATED\STANDARD DETAILS 5 STREETS DETAILS\DETAIL 5-2.DWG



ROADWAY WIDTH: 48'

RIGHT OF WAY WIDTH: 80' (MIN.)

TRAVEL LANES: TWO LANES, 11' WIDE.

LEFT TURN LANES: 12' WIDE AT INTERSECTION WHERE NEEDED.

BIKE LANES: TWO LANES, 7' WIDE.

PARKING: NONE. PARKING MUST BE PROVIDED OFF STREET FOR ANY DEVELOPMENT ADJOINING THE STREET.

PARKWAY: 8' (MIN.) WIDTH. ADDITIONAL WIDTH OPTIONAL.

SIDEWALK: 5' (MIN.) WIDTH. ADDITIONAL WIDTH MAY BE REQUIRED FOR HIGHER PEDESTRIAN TRAFFIC WITHIN AND LEADING TO ACTIVITY AREAS. IF SIDEWALK IS OMITTED, TOWN APPROVAL IS REQUIRED.

MEDIAN: IF MEDIANS ARE PROPOSED THEY MUST BE ACCEPTABLE TO THE TOWN.

WHERE USED: THESE SPECIFICATIONS SHALL APPLY AS REQUIRED BY THE LOCAL ENTITY, WHEN A COLLECTOR STREET IS SHOWN ON THE MASTER STREET PLAN OR WHEN THE TRAFFIC VOLUME ON THE STREET IS ANTICIPATED TO BE IN THE RANGE OF 3,500 TO 5,000 VEHICLES PER DAY.

DESIGN SPEED: 40 MPH

SPEED LIMIT: 30-35 MPH

ACCESS: ACCESS WILL BE LIMITED. POINTS OF ACCESS MUST BE APPROVED BY THE LOCAL ENTITY.

CONTINUITY: THE STREET SHALL BE CONTINUOUS FOR NO MORE THAN 1320 FEET.

FENCES: FENCES SHALL BE SETBACK A MINIMUM OF 3' FROM THE BACK EDGE OF THE SIDEWALK.

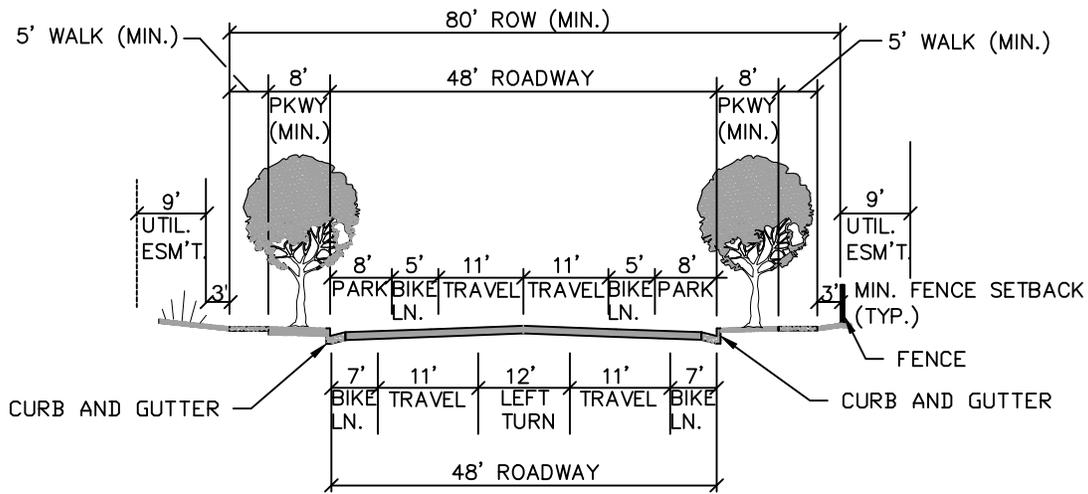
CURB AND GUTTER: VERTICAL CURB AND GUTTER OR BORROW DITCHES IF APPROVED BY THE TOWN.

STRIPING: STRIPE ENTIRE LENGTH OF STREETS.

STREET TREES: AS SHOWN ON LANDSCAPING PLAN TO BE APPROVED BY TOWN. REQUIRED SPACING IS 40' O.C.

LATEST REV.	MAJOR COLLECTOR STREET	DWG. REF.
March 2015	TOWN OF WELLINGTON, COLORADO	5-2

Plot Date: 3/3/2015 8:56 AM Plotted By: Bowen, Corey Date Created: 2/27/2015 V:\52873\FACTIVE\187310055\2014 DEVELOPMENT STANDARDS - UPDATED\STANDARD DETAILS 2014\AUTOCAD\DIV 5 STREETS DETAILS\DETAIL 5-3.DWG



INTERSECTIONS
(WHERE NEEDED)

ROADWAY WIDTH: 48'

RIGHT OF WAY WIDTH: 80' (MIN.)

TRAVEL LANES: TWO LANES, 11' WIDE.

LEFT TURN LANES: 12' WIDE AT INTERSECTIONS WHERE NEEDED.

BIKE LANES: TWO LANES, 5' WIDE. (7' WIDE WHERE ADJACENT TO CURB)

PARKING: TWO LANES, 8' WIDE; PARKING MAY BE REMOVED AT CERTAIN LOCATIONS TO PROVIDE A LEFT TURN LANE AT INTERSECTIONS WHERE NEEDED.

PARKWAY: 8' (MIN.) WIDTH. ADDITIONAL WIDTH OPTIONAL.

SIDEWALK: 5' (MIN.) WIDTH. ADDITIONAL WIDTH MAY BE REQUIRED FOR HIGHER PEDESTRIAN TRAFFIC WITHIN AND LEADING TO ACTIVITY AREAS.

MEDIAN: IF MEDIANS ARE PROPOSED THEY MUST BE ACCEPTABLE TO THE TOWN.

WHERE USED: THESE SPECIFICATIONS SHALL APPLY AS REQUIRED BY THE TOWN, WHEN A COLLECTOR STREET IS SHOWN ON THE MASTER STREET PLAN OR WHEN THE TRAFFIC VOLUME ON THE STREET IS ANTICIPATED TO BE IN THE RANGE OF 2,500 TO 3,500 VEHICLES PER DAY.

DESIGN SPEED: 40 MPH

SPEED LIMIT: 25-30 MPH

ACCESS: ACCESS WILL BE LIMITED. POINTS OF ACCESS MUST BE APPROVED BY THE TOWN.

CONTINUITY: THE STREET SHALL BE CONTINUOUS FOR NO MORE THAN 1320 FEET.

FENCES: FENCES SHALL BE SETBACK A MINIMUM OF 3' FROM THE BACK EDGE OF THE SIDEWALK.

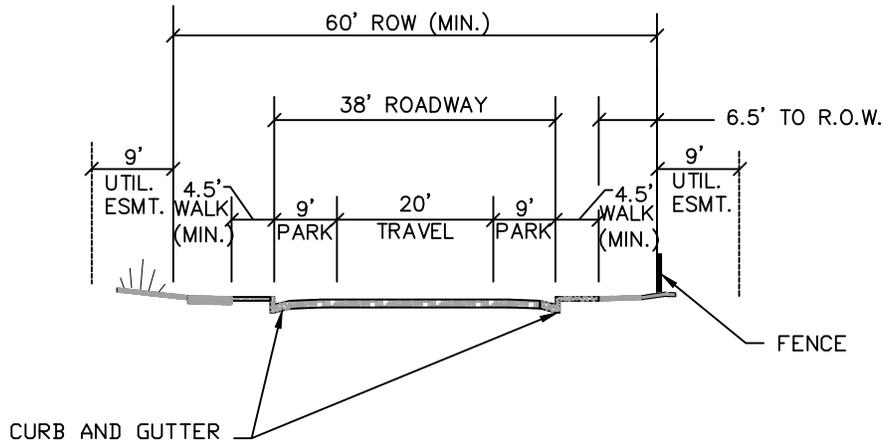
CURB AND GUTTER: VERTICAL CURB AND GUTTER, OR DRIVEOVER IF APPROVED BY THE TOWN.

STRIPING: STRIPE INTERSECTION APPROACHES ONLY.

STREET TREES: AS SHOWN ON LANDSCAPING PLAN TO BE APPROVED BY TOWN. REQUIRED SPACING IS 40' O.C.

LATEST REV.	MINOR COLLECTOR STREET	DWG. REF.
March 2015	TOWN OF WELLINGTON, COLORADO	5-3

Plot Date: 3/3/2015 8:57 AM Plotted By: Bowen, Corey
 Date Created: 2/27/2015 V:\52873\FACTIVE\187310055\2014 DEVELOPMENT STANDARDS - UPDATED\STANDARD DETAILS 2014\AUTOCAD\DIV 5 STREETS DETAILS\DETAIL 5-4.DWG



ROADWAY WIDTH: 38' WIDE.

RIGHT OF WAY WIDTH: 60' (MIN)

TRAVEL LANES: 20' WIDE.

LEFT TURN LANES: NONE.

BIKE LANES: BICYCLISTS TO SHARE TRAVEL LANE WITH MOTOR VEHICLES. ADDITIONAL STREET WIDTH, UP TO 4' WIDER, MAY BE REQUIRED IN THE TRAVEL LANE TO ACCOMMODATE BIKE TRAFFIC TO SERVE ACTIVITY AREAS, SUCH AS SCHOOLS AND PARKS.

PARKING: TWO LANES 9' WIDE.

SIDEWALK: 4.5' (MIN.) WIDTH. ADDITIONAL WIDTH MAY BE REQUIRED FOR HIGHER PEDESTRIAN TRAFFIC SERVING ACTIVITY AREAS.

MEDIANS: NONE.

WHERE USED: ALL RESIDENTIAL LOCAL STREETS WHERE TRAFFIC VOLUME IS ANTICIPATED TO BE 1000 VPD OR LESS

DESIGN SPEED: 25 MPH

SPEED LIMIT: 25 MPH

ACCESS: ACCESS WILL BE UNLIMITED IN ACCORDANCE WITH THESE STANDARDS.

CONTINUITY: THE STREET SHALL BE CONTINUOUS FOR NO MORE THAN 1320 FEET.

FENCES: FENCES SHALL BE SETBACK A MINIMUM OF 13' FROM THE EDGE OF PAVEMENT.

CURB AND GUTTER: VERTICAL CURB AND GUTTER, OR DRIVEOVER.

STRIPING: NO STRIPING NEEDED.

LATEST REV.

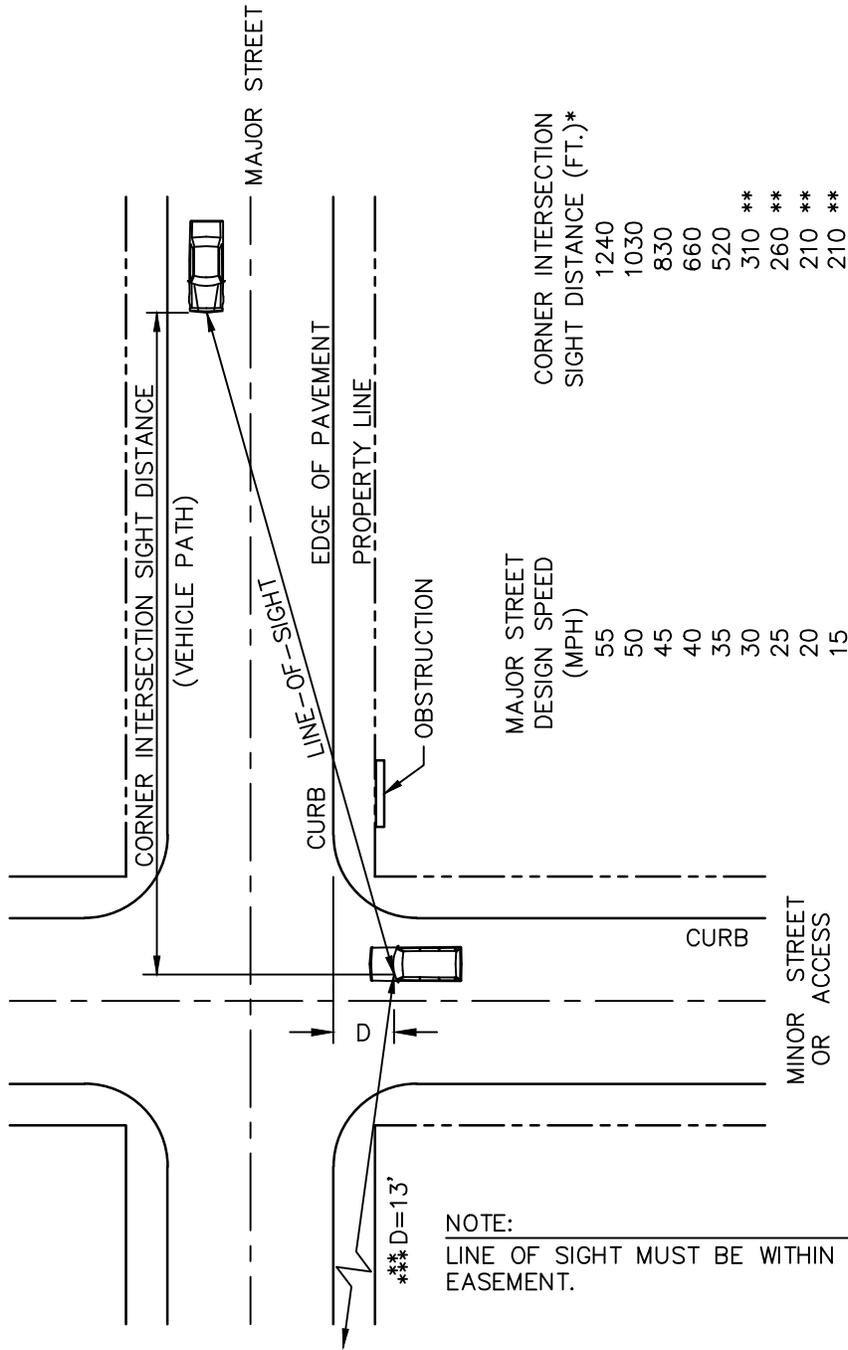
RESIDENTIAL LOCAL STREET

DWG. REF.

March 2015

TOWN OF WELLINGTON, COLORADO

5-4



**SIGHT DISTANCE AT INTERSECTIONS
(UNSIGNALIZED)**

FROM "A POLICY ON GEOMETRIC DESIGN OF HIGHWAYS AND STREETS 1990"
BY AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS

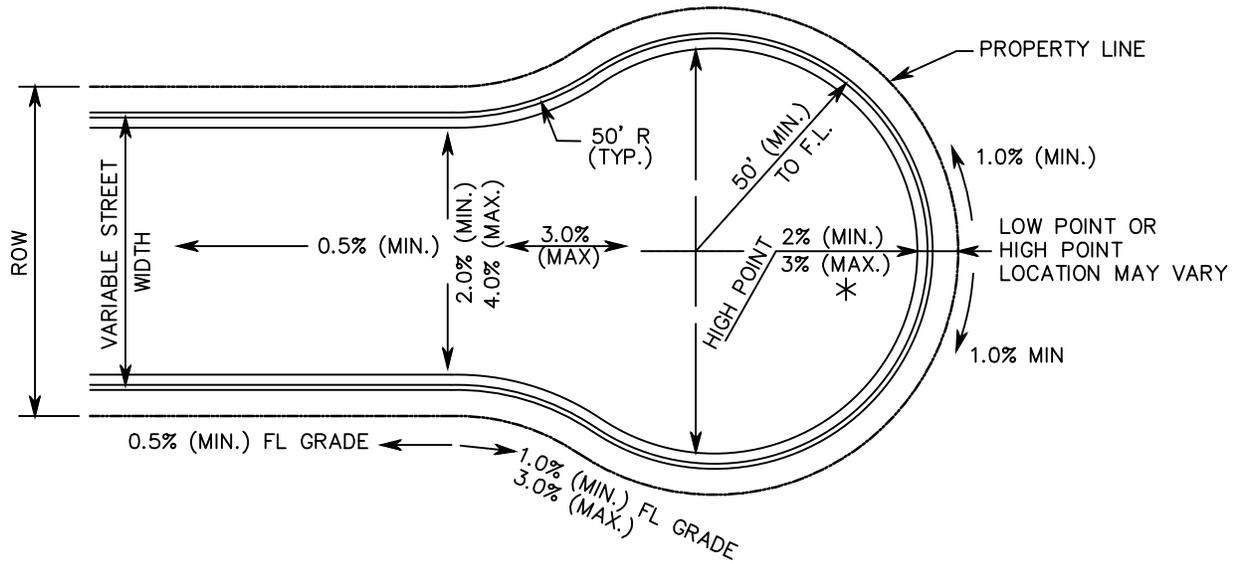
* CORNER SIGHT DISTANCE MEASURED FROM A POINT ON THE MINOR ROAD AT 13 FEET BACK FROM THE EDGE OF THE MAJOR ROAD PAVEMENT (FLOWLINE) AND MEASURED FROM A HEIGHT OF EYE AT 3.50 FEET ON THE MINOR ROAD TO A HEIGHT OF OBJECT AT 4.25 FEET ON THE MAJOR ROAD.
 ** AT LOCAL-LOCAL STREET INTERSECTIONS ONLY, THE "D" DISTANCE SHALL BE TEN FEET (10') AND THE SIGHT DISTANCE SHALL BE MEASURED TO THE CENTERLINE OF THE STREET.
 *** FOR PRIVATE DRIVEWAY ACCESS TO A PUBLIC STREET, USE 10 FEET BACK FROM FLOWLINE (OR SHOULDER FOR GRAVEL ROADS).

1. THESE VALUES APPLY TO PASSENGER CARS ON 2-LANE ROADS ONLY. INTERSECTIONS AND ACCESS SERVING TRUCKS OR ON MULTI-LANE ROADWAYS REQUIRES SEPARATE ANALYSIS.

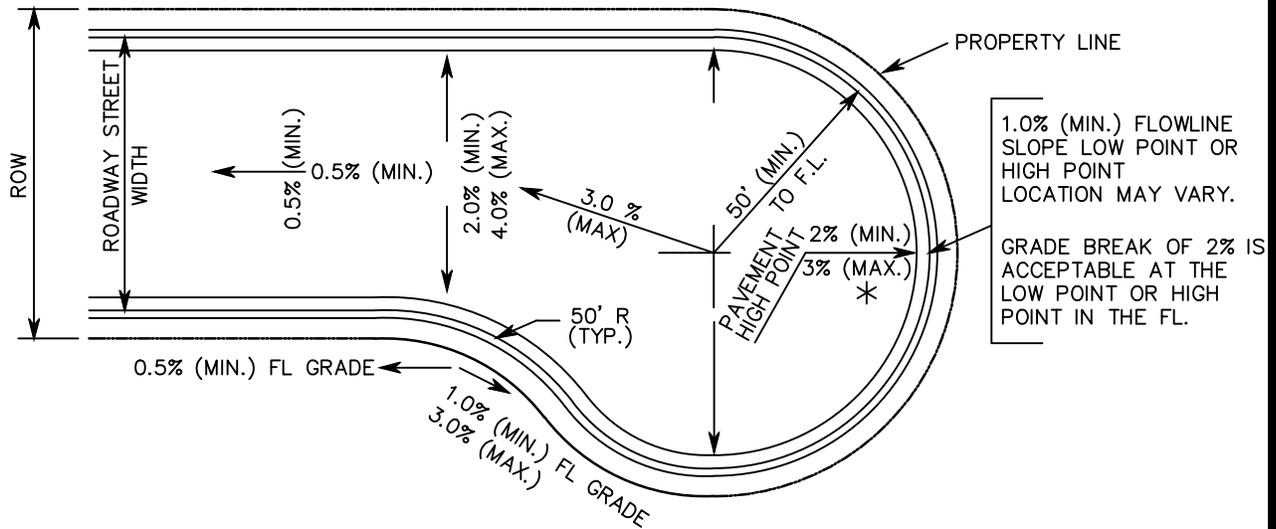
2. ADJUSTMENTS MAY BE REQUIRED FOR A SKEWED INTERSECTION.

LATEST REV.	SIGHT DISTANCE (SIGHT TRIANGLE)	DWG. REF.
March 2015	TOWN OF WELLINGTON, COLORADO	5-5

Plot Date: 3/3/2015 8:59 AM Plotted By: Bowen, Corey
 Date Created: 2/27/2015 V:\52873\FACTIVE\187310055\2014 DEVELOPMENT STANDARDS - UPDATED\STANDARD DETAILS 2014\AUTOCAD\DIV 5 STREETS DETAILS\DETAIL 5-6.DWG



DRIVE-OVER CURB, GUTTER AND SIDEWALK



CURB AND GUTTER w/ ATTACHED WALK

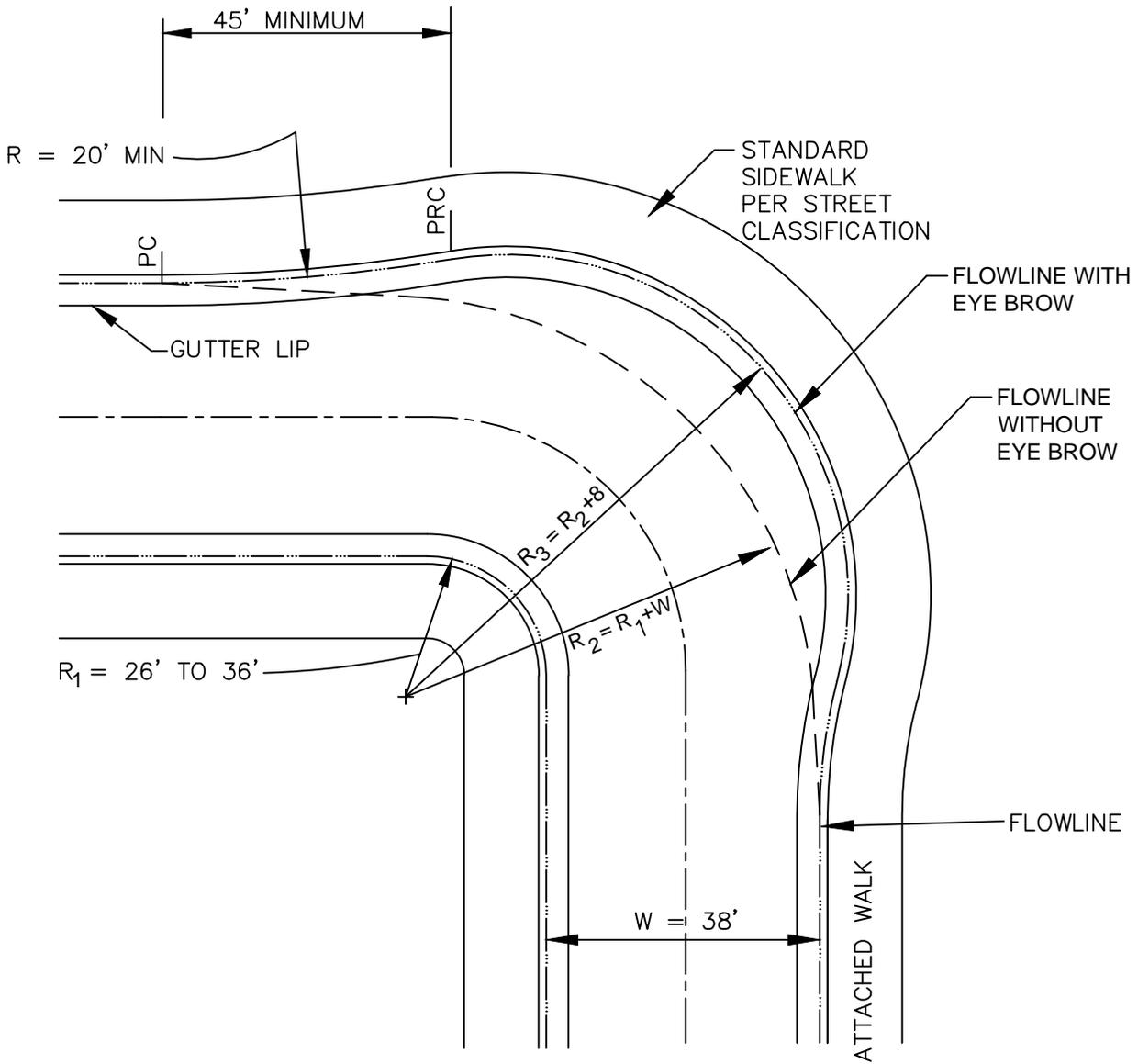
* MAXIMUM GRADE SHALL BE 4% ON RECONSTRUCTION.

NOTE:

1. CUL-DE-SAC MAY BE ASYMMETRICAL.

LATEST REV.	CUL-DE-SAC DETAIL	DWG. REF.
March 2015	TOWN OF WELLINGTON, COLORADO	5-6

Plot Date: 3/3/2015 9:00 AM Plotted By: Bowen, Corey
 Date Created: 2/27/2015 V:\52873\FACTIVE\187310055\2014 DEVELOPMENT STANDARDS - UPDATED\STANDARD DETAILS 2014\AUTOCAD\DIV 5 STREETS DETAILS\DETAIL 5-7.DWG



WIDENING DETAIL FOR TURNS > 60°
 LOCAL STREETS ONLY

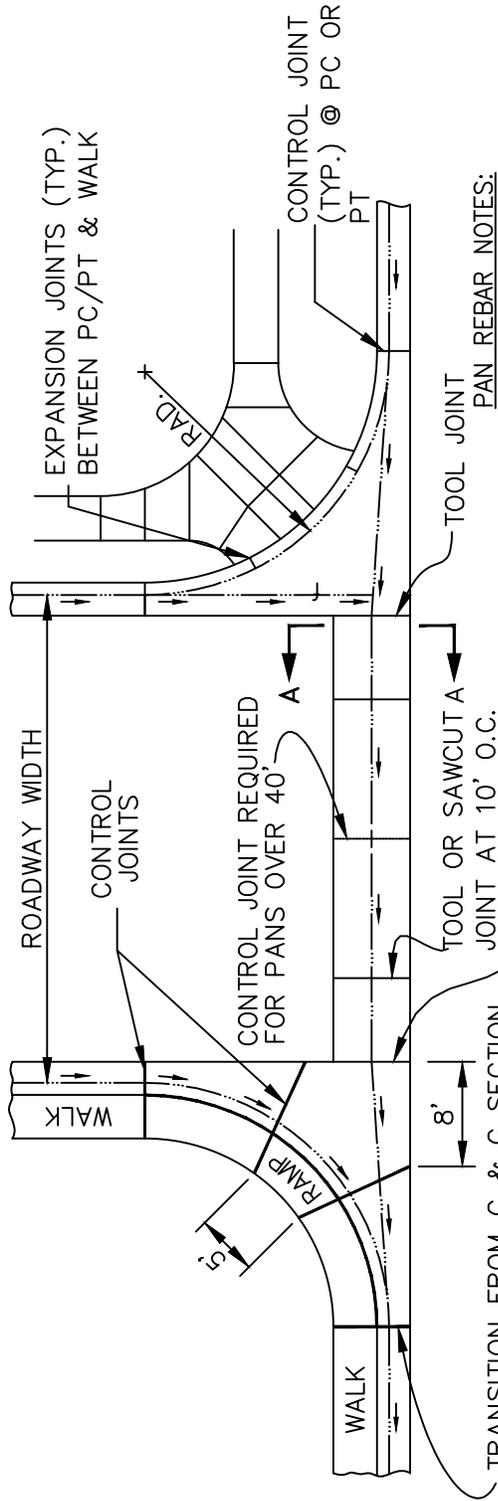
LATEST REV.

DWG. REF.

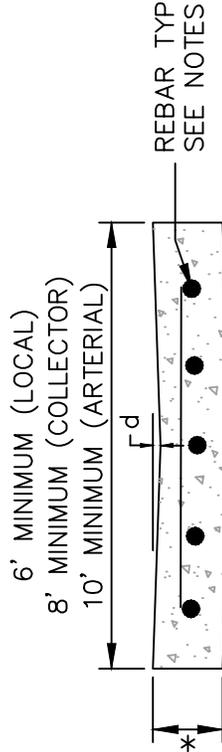
March 2015

TOWN OF WELLINGTON, COLORADO

5-7



- TOOL OR SAWCUT A JOINT AT 10' O.C.
- COLD JOINT DOWEL IF POUR SEPARATE FROM RETURN
- PLAN VIEW
1. INSTALL LONGITUDINAL REBAR (ALONG FLOWLINE) @ 12" O.C.
 2. INSTALL PERPENDICULAR REBAR (ACROSS FLOWLINE) @ 48" O.C.
 3. REBAR SHALL BE GR 60 # 4



* 8" MIN. FOR RESIDENTIAL, USE CONCRETE PAVEMENT DESIGN + 1/2" FOR COLLECTOR & ARTERIALS.

SECTION A-A

** 8' MIN. WIDTH WHERE CROSSING A COLLECTOR ROADWAY.

NOTE:
ALL INTERSECTIONS TO HAVE
ADA ACCESS RAMPS

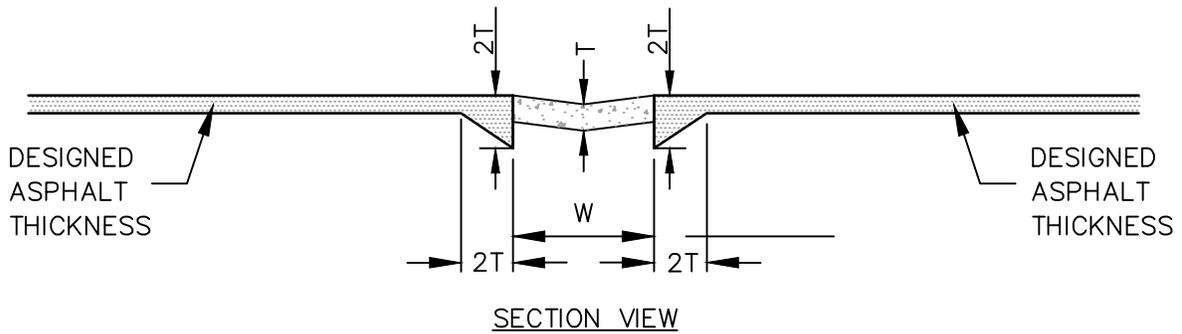
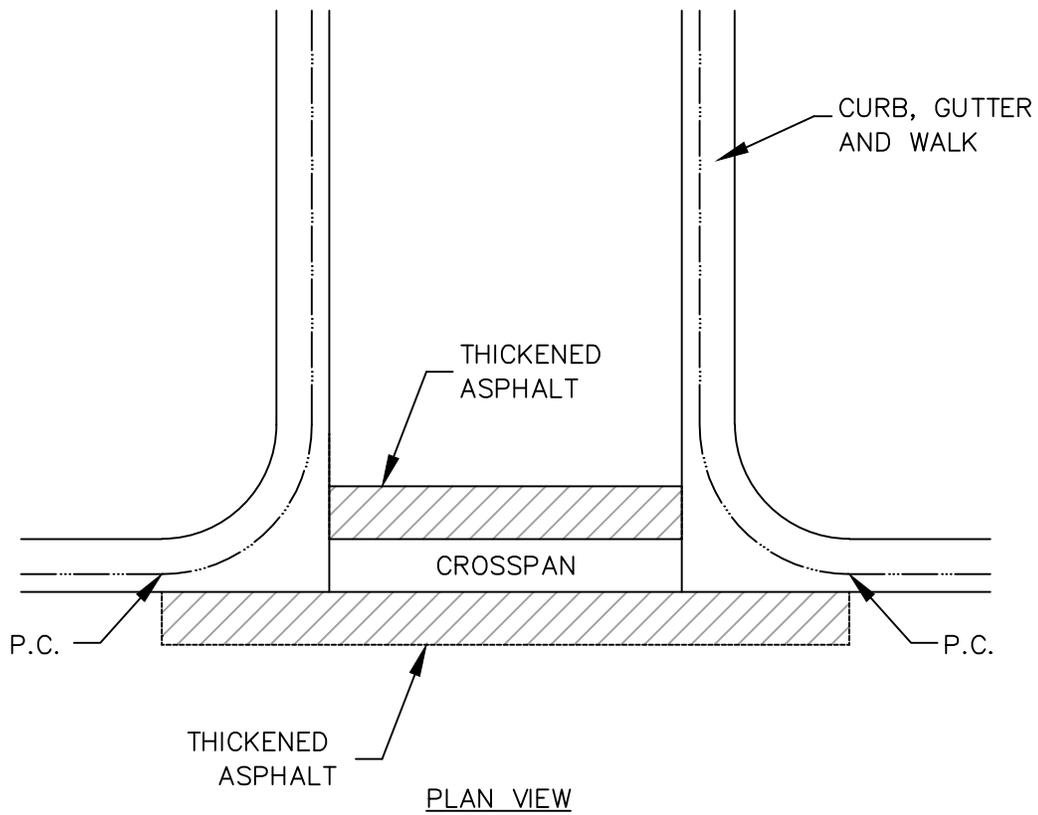
PARALLEL STREET CLASSIFICATION	W CROSS PAN WIDTH	DEPTH OF INVERT
ARTERIAL	10'	7/8"
COLLECTOR	8'	1 1/8"
LOCAL	6' **	1 1/2"

LATEST REV.	March 2015
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STREET INTERSECTION CROSSPAN
TOWN OF WELLINGTON, COLORADO

DWG. REF.	5-8
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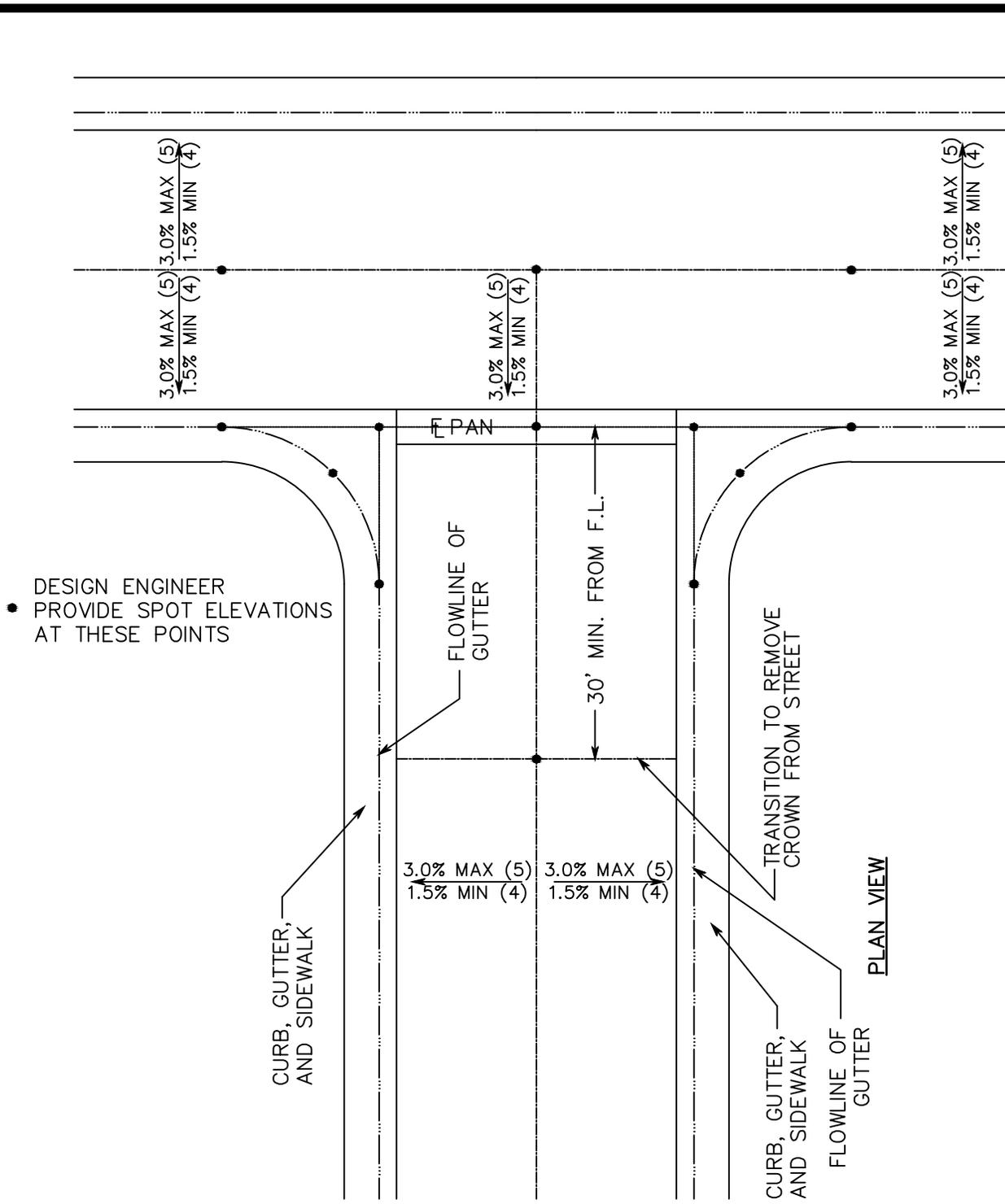
Plot Date: 3/3/2015 9:01 AM Plotted By: Bowen, Corey
 Date Created: 2/27/2015 V:\52873\FACTIVE\187310055\2014 DEVELOPMENT STANDARDS - UPDATED\STANDARD DETAILS 2014\AUTOCAD\DIV 5 STREETS DETAILS\DETAIL 5-9.DWG



T = THICKNESS OF CROSSPAN

W = WIDTH OF CROSSPAN

LATEST REV.	ASPHALT PAVING DETAIL (CROSS PAN)	DWG. REF.
March 2015	TOWN OF WELLINGTON, COLORADO	5-9



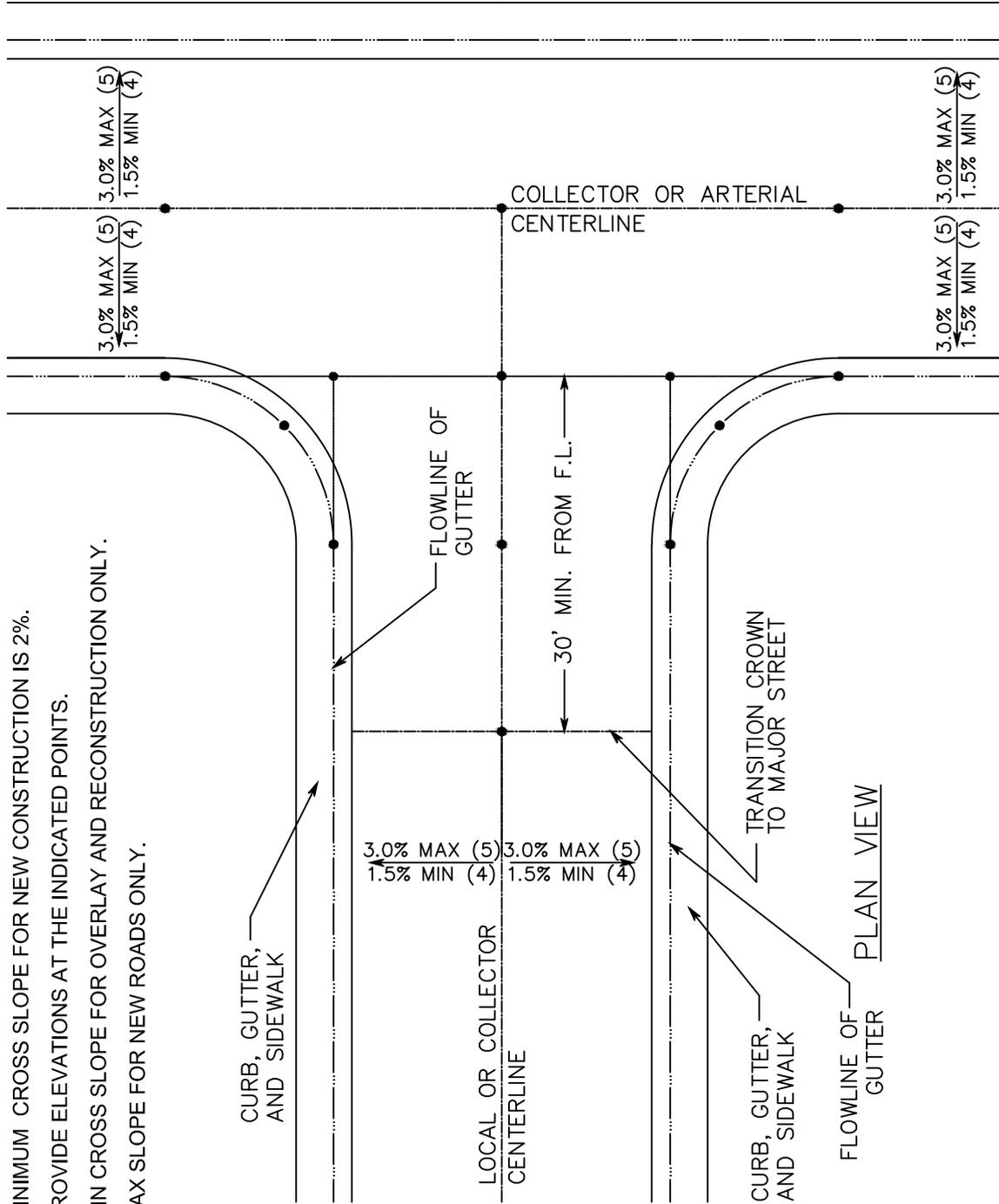
NOTE:

- (1) MAXIMUM SLOPE SHALL BE 4.0% ON RECONSTRUCTED PAVEMENT ONLY.
- (2) MINIMUM CROSS SLOPE FOR NEW CONSTRUCTION IS 2%.
- (3) PROVIDE ELEVATIONS AT THE INDICATED POINTS.
- (4) MIN CROSS SLOPE FOR OVERLAY AND RECONSTRUCTION ONLY.
- (5) MAX SLOPE FOR NEW ROADS ONLY.

LATEST REV.	STREET INTERSECTION APPROACH DETAIL W/ CROSSPAN	DWG. REF.
March 2015	TOWN OF WELLINGTON, COLORADO	5-10

NOTE:

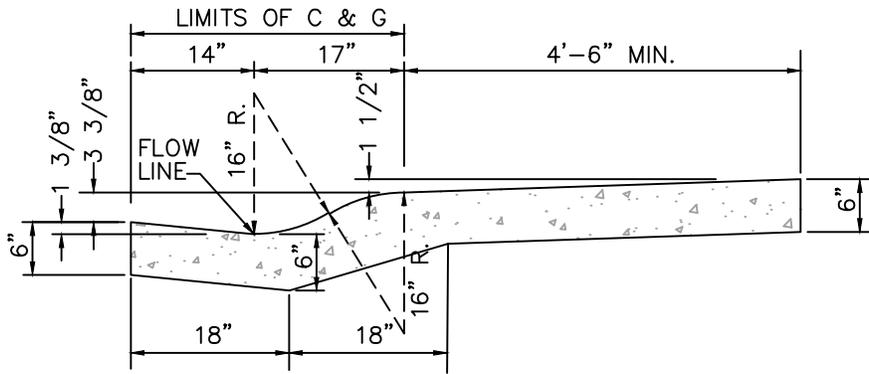
- (1) MAXIMUM SLOPE SHALL BE 4.0% ON RECONSTRUCTED PAVEMENT ONLY.
- (2) MINIMUM CROSS SLOPE FOR NEW CONSTRUCTION IS 2%.
- (3) PROVIDE ELEVATIONS AT THE INDICATED POINTS.
- (4) MIN CROSS SLOPE FOR OVERLAY AND RECONSTRUCTION ONLY.
- (5) MAX SLOPE FOR NEW ROADS ONLY.



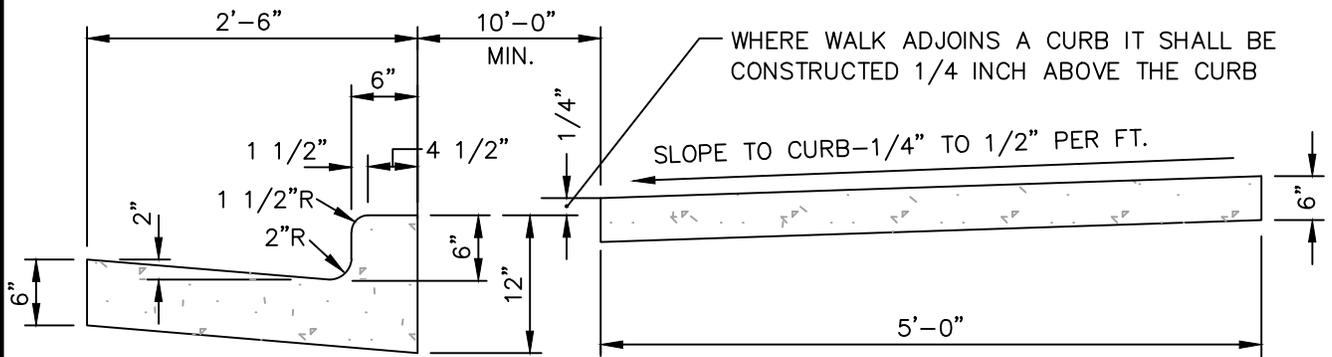
DESIGN ENGINEER
 • PROVIDE SPOT ELEVATIONS AT THESE POINTS

LATEST REV.	STREET INTERSECTION APPROACH DETAIL W/O CROSSPAN	DWG. REF.
March 2015	TOWN OF WELLINGTON, COLORADO	5-11

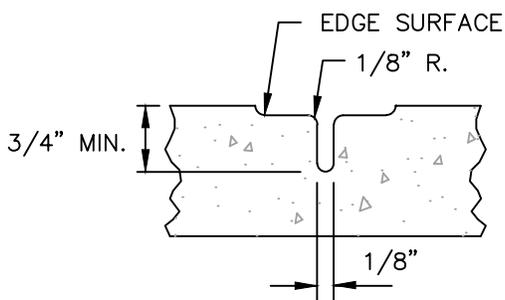
Plot Date: 3/3/2015 9:04 AM Plotted By: Bowen, Corey
 Date Created: 2/27/2015 V:\52873\FACTIVE\187310055\2014 DEVELOPMENT STANDARDS - UPDATED\STANDARD DETAILS 2014\AUTOCAD\DIV 5 STREETS_DETAILS\DETAIL 5-12.DWG



DRIVEOVER CURB, GUTTER & SIDEWALK
 N.T.S.

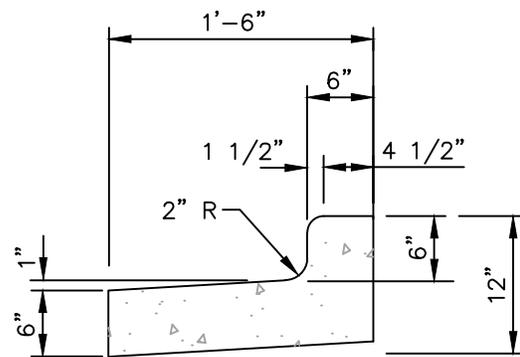


VERTICAL 6" CURB, GUTTER AND SIDEWALK
 N.T.S.



NOTE: JOINT SHALL BE CUT 1/4 THICKNESS OF CONCRETE INITIALLY

CONTROL JOINTS FOR WALKS
 N.T.S.



OUTFALL CURB & GUTTER
 N.T.S.

LATEST REV.	CURB AND GUTTER DETAILS	DWG. REF.
March 2015	TOWN OF WELLINGTON, COLORADO	5-12

LATEST REV.	GUIDELINES FOR DESIGN OF LEFT TURN LANES	DWG. REF.
March 2015	TOWN OF WELLINGTON, COLORADO	5-13

L_d/b -- LENGTH OF TAPER AND LANE FOR DECELERATION AND BRAKING

FUNCTIONAL BASIS: TO PROVIDE SUFFICIENT LENGTH FOR A VEHICLE TO DECELERATE AND BRAKE ENTIRELY OUTSIDE THE THROUGH TRAFFIC LANES.

DESIRABLE DESIGN: DECELERATION IN GEAR FOR 3 SECONDS (OCCURS OVER BAY TAPER) FOLLOWED BY COMFORTABLE BRAKING TO A STOPPED POSITION.

DESIGN VALUES FOR L_d/b

S--SPEED (MPH)	TOTAL	LENGTH (FT) LANE	BAY TAPER
30	235	115	(120)
40	315	155	(160)
50	435	235	(200)
60	530	290	(240)

MINIMUM DESIGN: BRAKING BEGINS AT 2/3 FULL LANE WIDTH, WITH MINIMUM 50-FOOT STORAGE. FOR LOW SPEEDS ONLY, THE FOLLOWING VALUES APPLY:

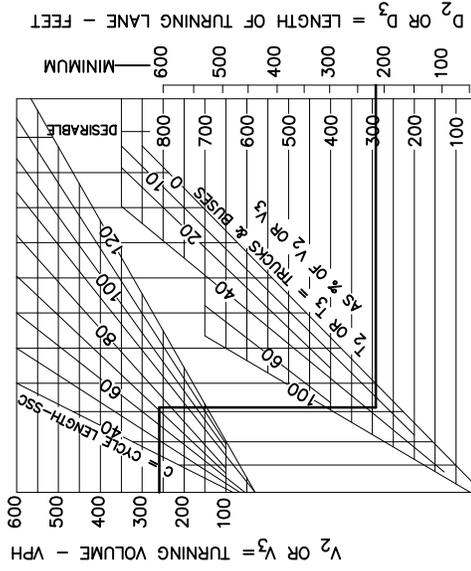
S--SPEED (MPH)	TOTAL	LENGTH (FT) LANE	BAY TAPER
30	230	50	(180)
35	250	70	(180)
40	280	100	(180)
45	320	140	(180)

L_s -- LENGTH OF LANE FOR STORAGE (FULL WIDTH LANE)
FUNCTIONAL BASIS: TO PROVIDE SUFFICIENT LENGTH FOR A REASONABLE NUMBER OF VEHICLES TO QUEUE WITHIN THE LANE WITHOUT AFFECTING OTHER LANES.

DESIRABLE DESIGN: BASED ON TWICE THE MEAN ARRIVAL RATE (PER CYCLE FOR SIGNALS, PER 2-MINUTE PERIOD FOR STOP CONTROL) DURING THE PEAK HOUR OF TRAFFIC.
MINIMUM DESIGN: BASED ON MEAN ARRIVAL RATE, WITH MINIMUM STORAGE FOR ONE VEHICLE.

L_s FOR STOP CONTROL	L_s (FT)
DHV (VPH) ≤ 60	50-75
61-120	100
121-180	150
>180	200 OR MORE

L_s FOR TRAFFIC SIGNAL CONTROL



LATEST REV.	GUIDELINES FOR DESIGN OF LEFT TURN LANES	DWG. REF.
March 2015	TOWN OF WELLINGTON, COLORADO	5-13

LATEST REV.	GUIDELINES FOR DESIGN TAPERS (LEFT TURN LANES)	DWG. REF.
March 2015	TOWN OF WELLINGTON, COLORADO	5-14

T_a --- APPROACH TAPER DESIGN (FT) (REDIRECT TAPER)

FUNCTIONAL BASIS: TO PROVIDE A SMOOTH LATERAL TRANSITION FOR ALL VEHICLES APPROACHING THE INTERSECTION.

FORM OF ALIGNMENT: TANGENT

LOW SPEED DESIGN: (<45) PROVIDE A FULLY SHADOWED LANE.

$$T_a = \frac{WS^2}{60} \quad W = \text{WIDTH OF OFFSET (FT)} \\ S = \text{SPEED (MPH)}$$

TYPICAL VALUES FOR T_a^*

S---SPEED (MPH)	W	---	WIDTH OF OFFSET (FT)
25	11	11.5	12
30	115	120	125
35	165	170	180
40	225	235	245
	295	305	320

*ROUNDED TO NEAREST 5 FT.

HIGH SPEED DESIGN: (≥ 45) PROVIDE A FULLY SHADOWED LANE. DESIGN AS FOLLOWS:

$$T_a = WS \quad W = \text{WIDTH OR OFFSET (FT)} \\ S = \text{SPEED (MPH)}$$

S---SPEED (MPH)	W	---	WIDTH OF OFFSET (FT)
45	11	11.5	12
50	495	520	540
	550	575	600

*ROUNDED TO NEAREST 5 FT.

T_b --- BAY TAPER DESIGN

FUNCTIONAL BASIS: TO DIRECT LEFT-TURNING VEHICLES INTO THE TURN LANE.

FORM OF ALIGNMENT: TANGENT; OR REVERSE CURVES WITH 1/3 OF THE TOTAL LENGTH COMPRISED OF A CENTRAL TANGENT.

DESIRABLE DESIGN: FOR FULLY SHADOWED LEFT TURN LANE.

$$T_b = \frac{W_1 S}{3} \quad W_1 = \text{WIDTH OF LANE} \\ S = \text{SPEED (MPH)}$$

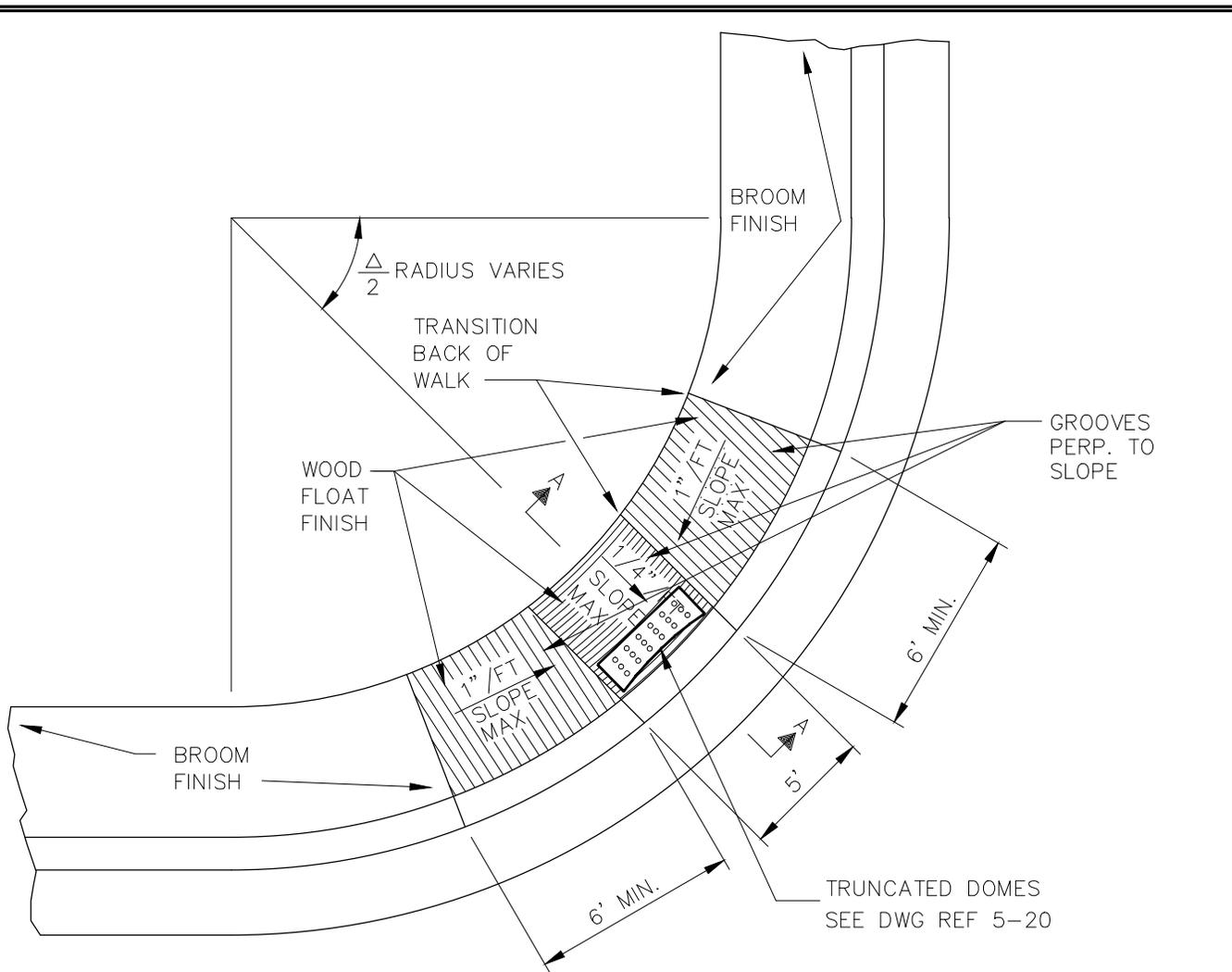
TYPICAL VALUES FOR T_b^*

S---SPEED (MPH)	W	---	WIDTH OF LANE (FT)
30	11		12
40	110		120
50	145		160
	185		200

*ROUNDED TO NEAREST 5 FT.

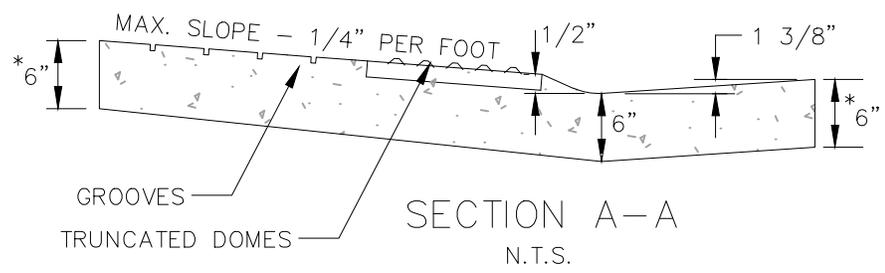
MINIMUM DESIGN: TAPER RATIOS OF 8:1 CAN BE USED FOR TANGENT BAY TAPERS IN CONSTRAINED LOCATIONS.

Plot Date: 4/21/2017 8:47 AM Plotted By: Oberschmidt, Mark
 Date Created: 2/27/2015 V:\52873F\ACTIVE\187310055\2014 DEVELOPMENT STANDARDS - UPDATED\STANDARD DETAILS 2015\AUTOCAD\DIV 5 STREETS DETAILS\DETAIL_5-16.DWG



CONSTRUCTION NOTES:

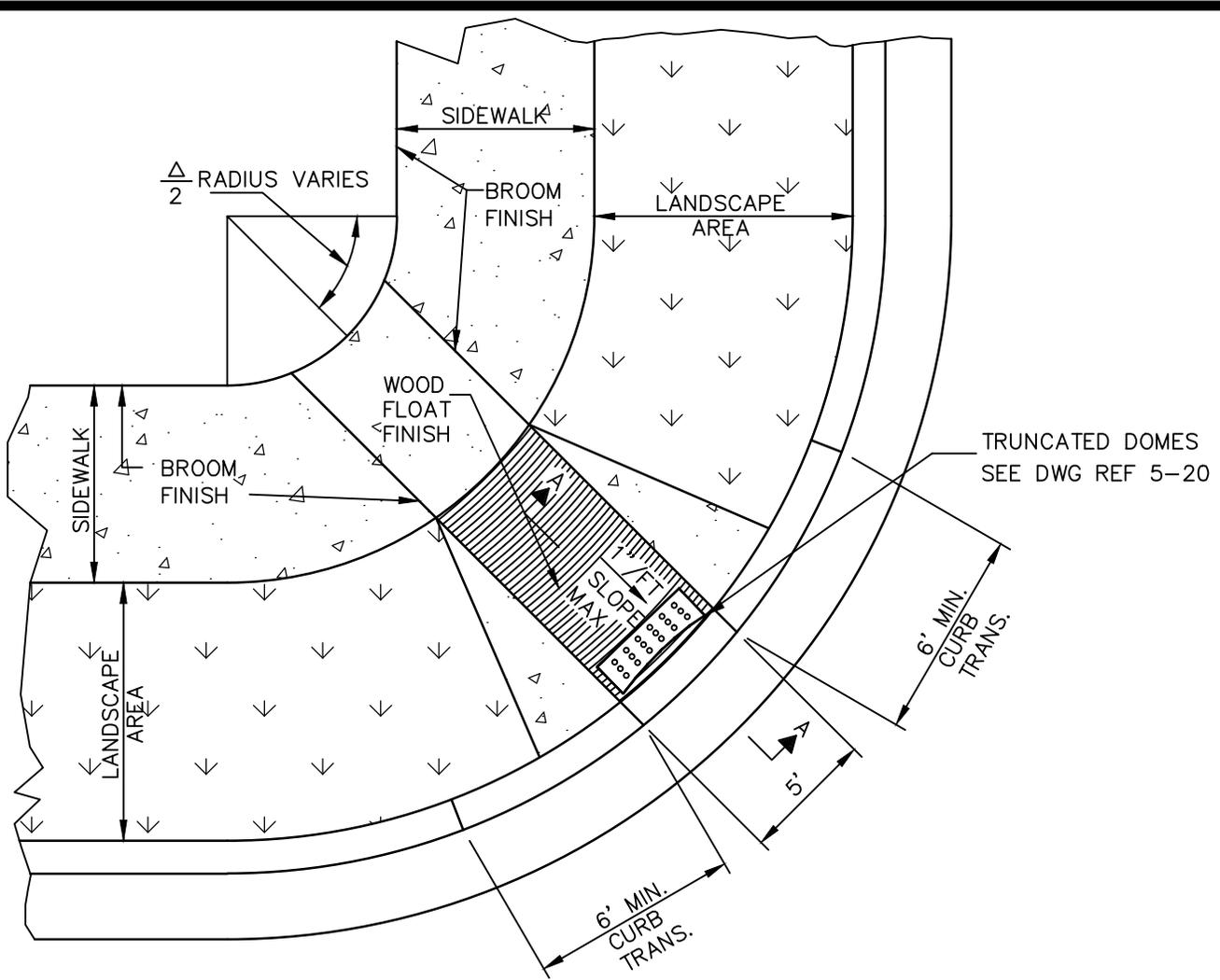
1. RAMP LANDING SHOULD BE CONCRETE COLORED WITH 4 LBS/SACK DAVIS NO.1117 (TILE RED) PIGMENT OR APPROVED EQUAL. DAVIS CLEAR SEALANT OR APPROVED EQUAL SHALL BE APPLIED ON ALL COLORED CONCRETE SURFACES
2. COLORED PORTION OF THE RAMP SHALL BE POURED SEPARATELY AND DOWELED INTO ADJACENT CONCRETE WITH MINIMUM OF 8 EQUALLY SPACED, 18-INCH #4 DEFORMED BARS DRIVEN 8-INCHES MINIMUM.
3. TRANSITIONS ARE TO BE SCORED PERPENDICULAR TO TRAVEL DIRECTION WITH 3/4-INCH DEEP TOOLED JOINTS AT 6-INCH ON CENTER



*6" DEPTH APPLIES FOR ENTIRE CURB RETURN AREA (PC TO PC)

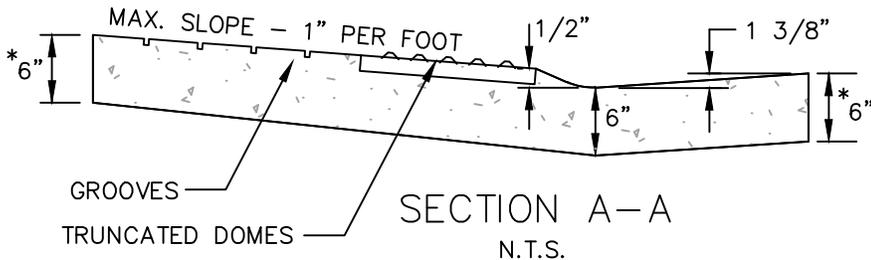
LATEST REV.	ACCESS RAMP DETAIL – ATTACHED WALK	DWG. REF.
APRIL 2017	TOWN OF WELLINGTON, COLORADO	5-16

Plot Date: 3/3/2015 9:07 AM Plotted By: Bowen, Corey
 Date Created: 2/27/2015 V:\52873\FACTIVE\187310055\2014 DEVELOPMENT STANDARDS - UPDATED\STANDARD DETAILS 2014\AUTOCAD\DIV 5 STREETS DETAILS\DETAIL 5-17.DWG



CONSTRUCTION NOTES:

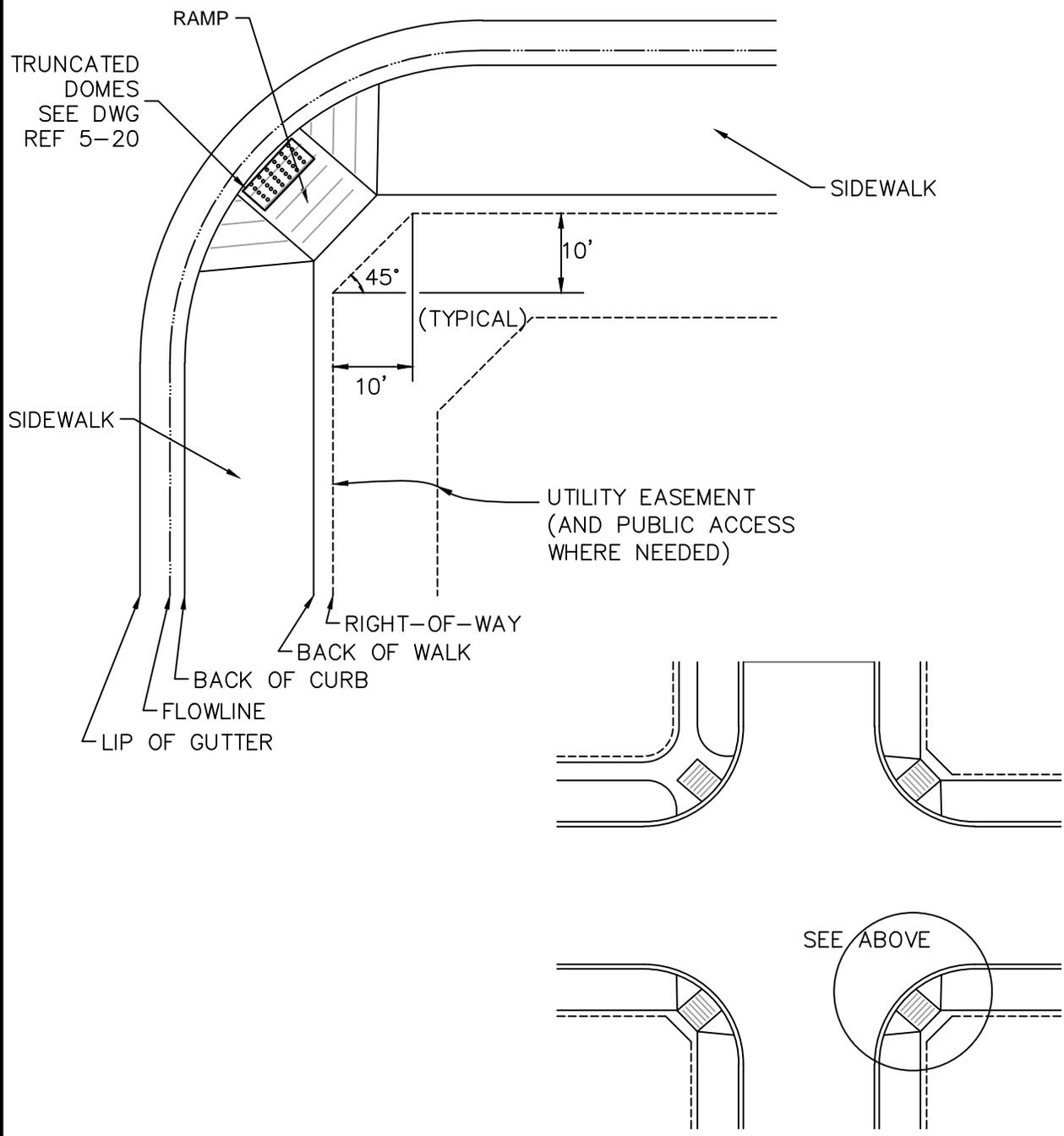
1. RAMP LANDING SHOULD BE CONCRETE COLORED WITH 4 LBS/SACK DAVIS NO.1117 (TILE RED) PIGMENT OR APPROVED EQUAL. DAVIS CLEAR SEALANT OR APPROVED EQUAL SHALL BE APPLIED ON ALL COLORED CONCRETE SURFACES
2. COLORED PORTION OF THE RAMP SHALL BE POURED SEPARATELY AND DOWELED INTO ADJACENT CONCRETE WITH MINIMUM OF 8 EQUALLY SPACED, 18-INCH #4 DEFORMED BARS DRIVEN 8-INCHES MINIMUM.
3. TRANSITIONS ARE TO BE SCORED PERPENDICULAR TO TRAVEL DIRECTION WITH 3/4-INCH DEEP TOOLED JOINTS AT 6-INCH ON CENTER



*6" DEPTH APPLIES FOR ENTIRE CURB RETURN AREA (PC TO PC)

LATEST REV.	ACCESS RAMP DETAIL – DETACHED WALK	DWG. REF.
March 2015	TOWN OF WELLINGTON, COLORADO	5-17

Plot Date: 3/3/2015 9:08 AM Plotted By: Bowen, Corey
 Date Created: 2/27/2015 V:\52873\ACTIVE\187310055\2014 DEVELOPMENT STANDARDS - UPDATED\STANDARD DETAILS 2014\AUTOCAD\DIV 5 STREETS DETAILS\DETAIL 5-18.DWG

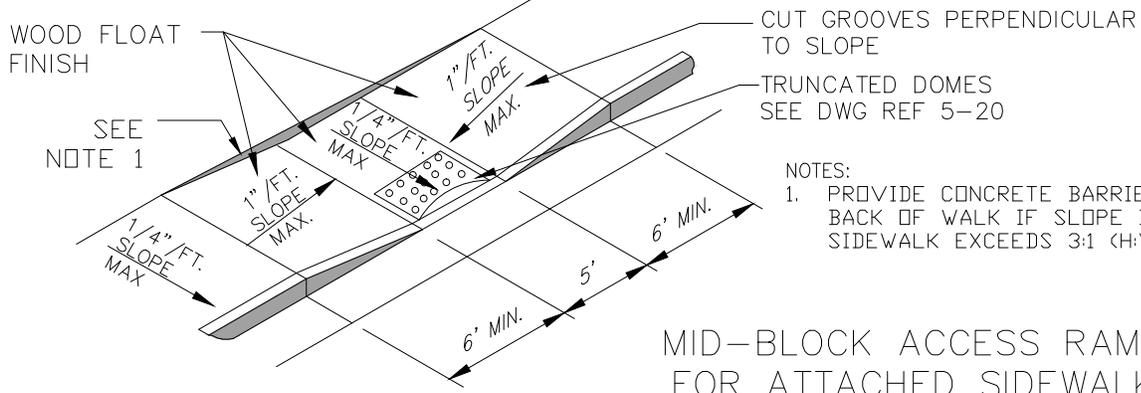


NOTES:

1. RIGHT OF WAY MUST BE DEDICATED IN THE FORM OF A RADIUS OR CORNER CUT TO INCLUDE ALL OF THE REQUIRED PUBLIC IMPROVEMENTS. HOWEVER, SIDEWALK MAY BE PLACED IN A PUBLIC EASEMENT WHEN APPROVED BY THE TOWN.
2. EASEMENTS AT THE CORNER MUST BE DEDICATED TO PROVIDE CORNER CUTS SIMILAR TO ROW.

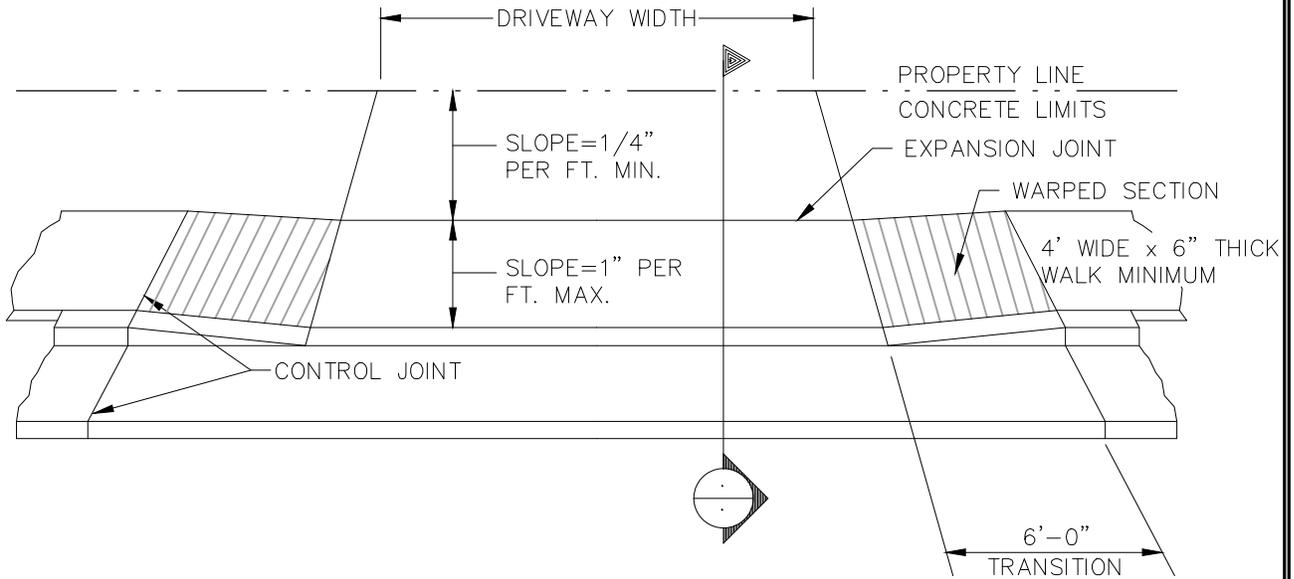
LATEST REV.	RIGHT-OF-WAY REQUIREMENTS AT INTERSECTIONS	DWG. REF.
March 2015	TOWN OF WELLINGTON, COLORADO	5-18

Plot Date: 11/22/2016 1:17 PM Plotted By: Oberschmidt, Mark
 Date Created: 2/27/2015 V:\52873\FACTIVE\187310055\2014 DEVELOPMENT STANDARDS - UPDATED\STANDARD DETAILS 2015\AUTOCAD\DIV 5 - STREETS DETAILS\DETAIL_5-19.DWG

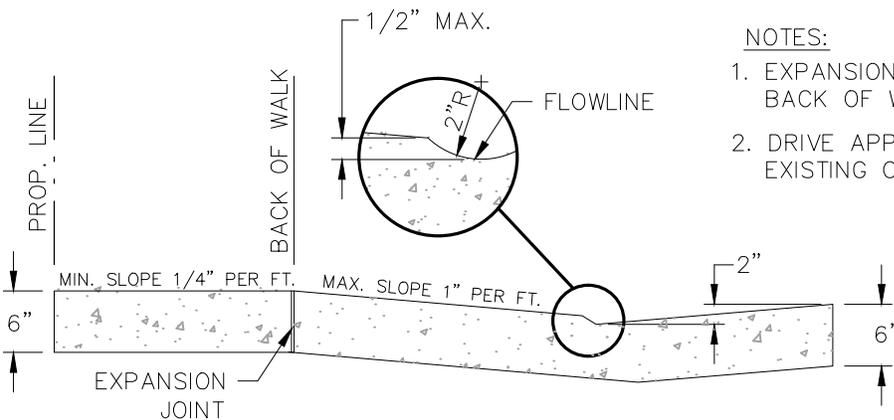


- NOTES:
1. PROVIDE CONCRETE BARRIER CURB AT BACK OF WALK IF SLOPE BEHIND SIDEWALK EXCEEDS 3:1 (H:V)

MID-BLOCK ACCESS RAMP FOR ATTACHED SIDEWALK



DRIVEWAY PERSPECTIVE VIEW

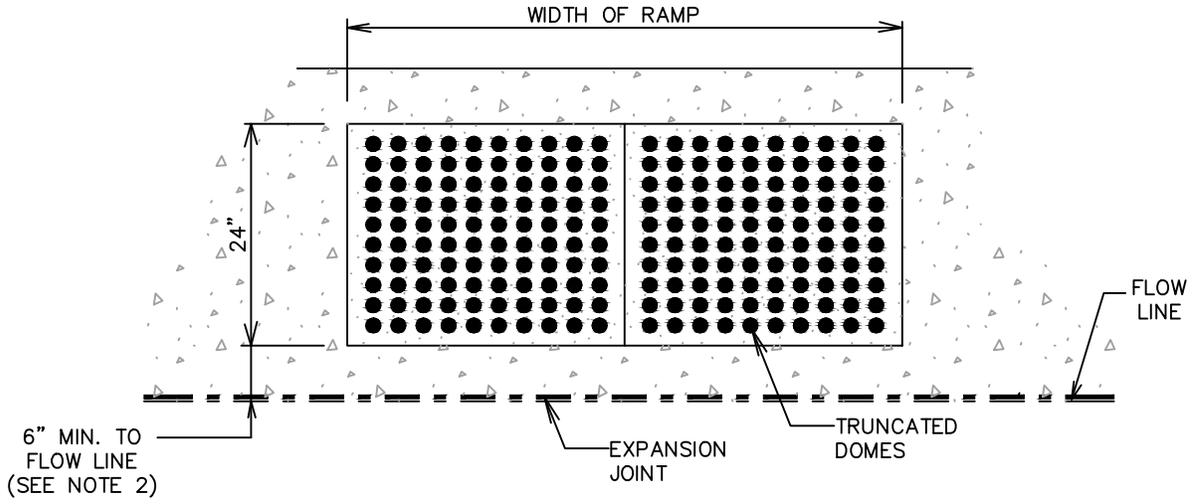


- NOTES:
1. EXPANSION JOINT TO BE PROVIDED AT BACK OF WALK.
 2. DRIVE APPROACHES SHALL MATCH EXISTING CONDITIONS.

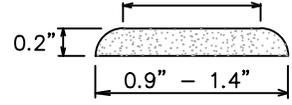
DRIVEWAY SECTION A-A

LATEST REV.	DRIVEWAY APPROACH & MID-BLOCK ACCESS RAMP	DWG. REF.
NOV 2016	TOWN OF WELLINGTON, COLORADO	5-19

Plot Date: 3/3/2015 9:09 AM Plotted By: Bowen, Corey
 Date Created: 2/27/2015 V:\52873\ACTIVE\187310055\2014 DEVELOPMENT STANDARDS - UPDATED\STANDARD DETAILS\2014\AUTOCAD\DIV 5 - STREETS - DETAILS\DETAIL 5-20.DWG



THE TOP DIAMETER OF THE TRUNCATED DOMES SHALL BE 65% OF THE BASE DIAMETER

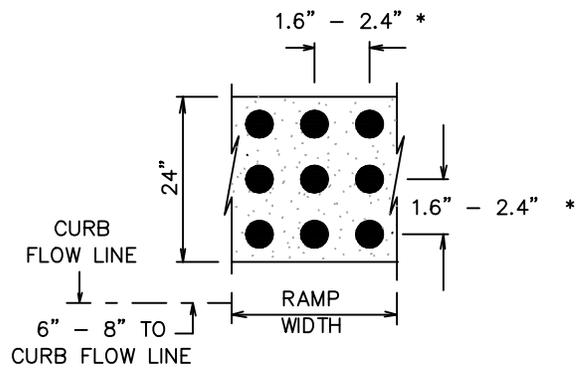


GENERAL NOTES:

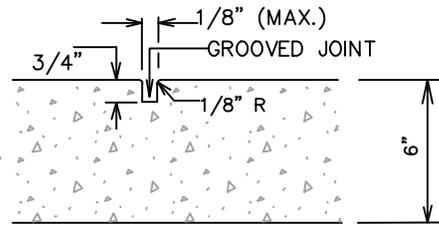
1. TRUNCATED DOMES SHALL BE INSTALLED AT SIDEWALK/ STREET INTERSECTIONS. THE DOMES SHALL BE PLACED IN A PATTERN GRID.
2. TRUNCATED DOMES SHALL BE INSTALLED A MINIMUM OF 6 INCHES FROM THE FLOW LINE OF THE CURB AND NOT BE MORE THAN A MAXIMUM OF 8 INCHES FROM THE FLOW LINE.
3. ALL TRUNCATED DOMES SHALL BE 24 INCHES IN LENGTH AND COVER THE COMPLETE WIDTH OF THE RAMP AREA.
4. RAMP SLOPES SHALL NOT BE STEEPER THAN 1" PER FOOT (12:1) THE TRUNCATED DOME SLOPE SHALL NOT BE STEEPER THAN 0.6" PER FOOT(20:1).

CONSTRUCTION NOTES:

THE RAMP AREA SHALL RECEIVE A COARSER BRUSH TREATMENT THAN THE SIDEWALK.



* SHALL BE EQUAL IN BOTH DIRECTIONS



JOINT SHALL BE TOOLED IN LIEU OF SAWCUTTING AT TIME OF RAMP INSTALLATION BEFORE CONCRETE HAS HARDENED.

LATEST REV.	CURB RAMP DETECTABLE WARNING & CONTRACTION JOINT DETAIL	DWG. REF.
March 2015	TOWN OF WELLINGTON, COLORADO	5-20

PAVEMENT MARKINGS

CROSSWALK MARKINGS:

AN ENGINEERING STUDY SHOULD BE REQUIRED BEFORE CROSSWALK MARKINGS ARE INSTALLED IN LOCATIONS AWAY FROM TRAFFIC SIGNALS OR STOP SIGNS. CONTINENTAL CROSSWALK BARS (1.5' X 9' TYP.) SHALL BE PLACED ADJACENT TO THE PROJECTED FLOWLINE OR ABUTTING TO EXISTING CROSSSPAN. A BAR SHALL BE PLACED CENTERED ON EACH LANE LINE AND IN THE CENTER OF EACH LANE. LANES 5' WIDE OR LESS SHALL NOT RECEIVE A BAR CENTERED IN THE LANE. IT IS IMPORTANT THAT THE MARKINGS ARE IN ALIGNMENT WITH THE ACCESS RAMPS / SIDEWALKS.

STRIPING:

ALL LONGITUDINAL (LANE) STRIPING SHALL TERMINATE AT THE CONTINENTAL CROSSWALK BARS -- EXCEPT THE DOWNSTREAM BIKE LANE WHICH SHALL TERMINATE AT THE CURB RETURN. IF A STOP LINE IS IN PLACE -- UPSTREAM STRIPING SHALL TERMINATE AT THE STOP LINE.

PREFERENTIAL LANE SYMBOL:

PLS SHALL BE USED FOR DESIGNATED BIKEWAYS. INTERSECTION PLACEMENT -- THE SYMBOL SHALL BE PLACED DOWNSTREAM TO CONVEY TO TURNING TRAFFIC THAT THE BIKE LANE EXISTS. IT SHALL BE PLACED 4" DOWN FROM THE PCR & CENTERED ON THE BIKE LANE. FREQUENCY OF PLACEMENT BETWEEN BLOCKS IS A MATTER FOR ENGINEERING JUDGEMENT.

NOT REQUIRED WITH LANE LENGTHS LESS THAN 100'.

BROKEN LINE 4" WHITE
10' SEGMENTS
30' GAPS
(3:1 RATIO)

LINE 4" WHITE

DOUBLE LINE
4" YELLOW
4" SPACE
4" YELLOW

PROJECTED FLOWLINE (FL)

STOP LINES:

PLACE STOP LINES (1.5' X VARIABLE TYP.) ONLY WHEN IMPORTANT TO INDICATE THE POINT BEHIND WHICH VEHICLES ARE REQUIRED TO STOP (MORE OFTEN ON MAIN ARTERIALS) -- PLACEMENT SHOULD ORDINARILY BE 4' IN ADVANCE OF AND PARALLEL TO THE NEAREST CROSSWALK LINE IN THE ABSENCE OF A MARKED CROSSWALK, THE STOP LINE SHOULD BE PLACED AT THE DESIRED STOPPING POINT NO MORE THAN 30' OR LESS THAN 4' FROM THE NEAREST EDGE OF THE INTERSECTING ROADWAY.

8" WHITE LINE
4" WHITE LINE

NOT REQUIRED WITH LANE LENGTHS LESS THAN 100'.

MANDATORY MOVEMENT:

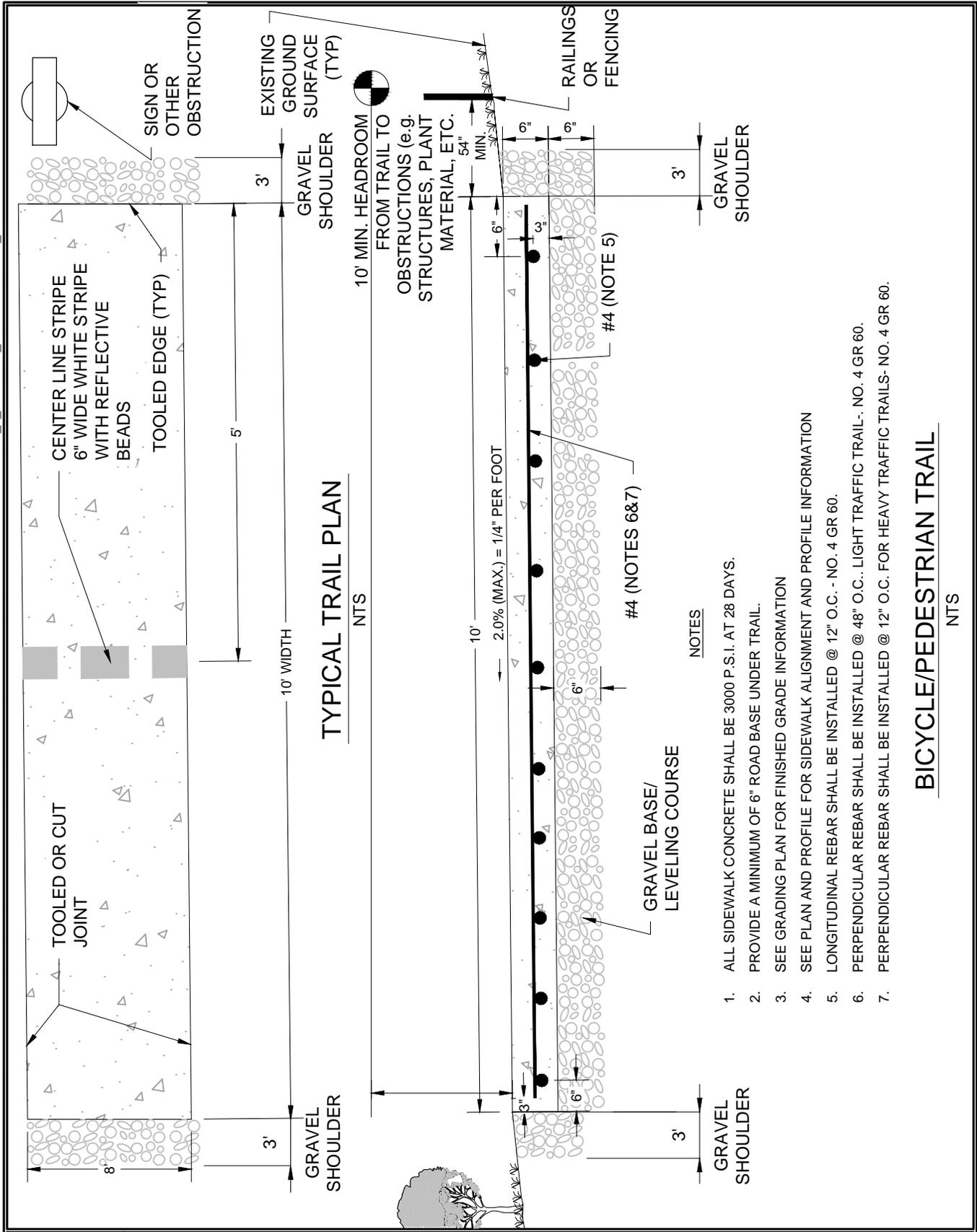
MANDATORY MOVEMENT LANES SHALL USE A LANE-USE ARROW MARKING, THE WORD MARKING "ONLY", ANOTHER LANE-USE ARROW MARKING (ACCOMPANIED BY SIGNS). SYMBOLS & WORDS ARE 8' OR MORE IN HEIGHT -- USE CDOT SPECIFICATION SIZES.

4" WHITE EXTENSION LINE
8" WHITE EXTENSION LINE

ON CURVES:
DOTTED EXTENSION OF LANE EDGE WITH SAME AS SOLID DOWNSTREAM LINE, 2' SEGMENTS, 4' GAPS.

Plot Date: 3/3/2015 9:10 AM Plotted By: Bowen, Corey
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LATEST REV.	STANDARD PAVEMENT MARKINGS W/TURN LANES	DWG. REF.
March 2015	TOWN OF WELLINGTON, COLORADO	5-21



TYPICAL TRAIL PLAN
NTS

NOTES

1. ALL SIDEWALK CONCRETE SHALL BE 3000 P.S.I. AT 28 DAYS.
2. PROVIDE A MINIMUM OF 6" ROAD BASE UNDER TRAIL.
3. SEE GRADING PLAN FOR FINISHED GRADE INFORMATION
4. SEE PLAN AND PROFILE FOR SIDEWALK ALIGNMENT AND PROFILE INFORMATION
5. LONGITUDINAL REBAR SHALL BE INSTALLED @ 12" O.C. - NO. 4 GR 60.
6. PERPENDICULAR REBAR SHALL BE INSTALLED @ 48" O.C.. LIGHT TRAFFIC TRAIL- NO. 4 GR 60.
7. PERPENDICULAR REBAR SHALL BE INSTALLED @ 12" O.C. FOR HEAVY TRAFFIC TRAILS- NO. 4 GR 60.

BICYCLE/PEDESTRIAN TRAIL
NTS

LATEST REV.	CONCRETE TRAIL TOWN OF WELLINGTON, COLORADO	DWG. REF.
March 2015		5-22